3. Waste Area Group 5 Comprehensive Remedial Investigation

CONTENTS

FIGURE

TABLES

3. WASTE AREA GROUP 5 COMPREHENSIVE REMEDIAL INVESTIGATION

The WAG 5 comprehensive RI/BRA addresses the contamination from the 55 sites identified in the FFA/CO Action Plan (DOE-ID 1991). Previous decisions for each of the 54 sites in WAG 5 were reviewed during the scoping of the RI/FS and one potential release site that has been identified and proposed for listing (ARA-25). Therefore, a brief description and summary of the investigations that have been conducted for each site are presented below in Section 3.1. The data needs defined in the WAG 5 comprehensive RI/FS Work Plan (DOE-ID 1997), the sampling to fill the data needs, and deviations from planned sampling are included. A discussion of the data quality associated with the analytical results for the WAG 5 Field Sampling Plan (FSP) contained in the WAG 5 Work Plan (DOE-ID 1997) is provided in Section 3.2, and the analytical results are presented in Appendix E. The facilities assessment analysis, conducted to ensure that the WAG 5 BRA captures all WAG 5 sources of contamination with a potential impact on cumulative risk estimates, is summarized in Section 3.3. The sites retained for the comprehensive BRA are identified in Section 3.4.

3.1 Site Summaries

Each of the 55 sites in WAG 5 is summarized below. The summaries include site descriptions, previous investigations, the data needs defined in the WAG 5 Work Plan (DOE-ID 1997), sampling performed under the WAG 5 FSP (DOE-ID 1997), and deviations from the planned sampling. The locations of the 55 sites are illustrated in Figures 2-5 and 2-6.

3.1.1 ARA-01: ARA-I Chemical Evaporation Pond (ARA-745)

The ARA-01 site is a shallow, unlined surface impoundment that was used to dispose of laboratory wastewater from the ARA-I Shop and Maintenance Building (ARA-627). The pond, located southeast of the ARA-627 building, was constructed in 1970 by excavating native soil to create a topographic depression. Basalt outcrops are present within and immediately adjacent to the pond. The maximum surface soil depth within the pond is 1.1 m (3.5 ft) and the average surface soil depth is approximately 0.5 m (1.5 ft). The pond received process discharges that until 1988 contained small quantities of radioactive substances, acids, bases, and VOCs. The pond is now dry except during spring runoff and heavy precipitation.

The chemical evaporation pond sediments were investigated from 1982 to 1990 and again in 1997 for the presence of contamination. Metals, VOCs, and radionuclides were detected in the sediments in investigations before 1990 (Stanisich et al. 1992). Arsenic, chromium(III), chromium(IV), cadmium, beryllium, Cs-134, Cs-137, Co-60, Pu-239, and U-234 were detected in the 1990 sampling campaign (Stanisich et al. 1992). The maximum concentration of radionuclides in these samples was 297 pCi/g of Cs-137, 11.4 pCi/g of Cs-134, 8.14 pCi/g of Co-60, 2.6 pCi/g of Pu-239, and 1.6 pCi/g of U-234. The samples with the highest contaminant concentrations were collected adjacent to the pond inlet. To determine background metal concentrations, 10 samples also were taken south of the pond in an area unaffected by ARA activities.

The conclusion of the ARA-01 Record of Decision (ROD) (DOE-ID 1992) was that no remedial action is necessary to protect human health and the environment. However, the ROD stipulated that additional evaluation of subsurface conditions and the groundwater pathway would be conducted in a future investigation that will be completed before the INEEL Site-wide ROD is finalized. Consequently, a data need was identified in the WAG 5 Work Plan (DOE-ID 1997) to determine the vertical extent of the contamination. To meet this data need, two boreholes were planned at biased locations, meaning that

samples would be collected at the locations of the highest expected contaminant concentrations (i.e., the location of the highest previously detected Cs-137 concentration, and in the area of the pond with the lowest elevation). For both boreholes, sample collection was planned at depths of 0 to 15 cm (0 to 6 in.), 1 to 1.2 m (3.5 to 4 ft), and 2.9 to 3 m (9.5 to 10 ft) and in the first interbed at an estimated depth of 7.6 m (25 ft) bls.

During drilling, it became apparent that the basalt was too near the surface (the soil is only 0.6 m [2 ft] thick) to collect the samples at 1 to 1.2 m (3.5 to 4 ft) or 2.9 to 3 m (9.5 to 10 ft). It also became apparent that a 7.6-m (25-ft) interbed does not exist beneath the pond and the subsurface geology consists of fracture and rubble zones. The first borehole was drilled to a depth of 28.7 m (94 ft) without encountering an interbed, and the second borehole was drilled to a depth of 36 m (118 ft), also without encountering an interbed. At 36 m (118 ft), the drill string and bit became stuck and only part of the drill string, the top 10.7 m (35 ft), was recovered. Therefore, no subsurface samples were obtained from either borehole (Wilson-Lopez 1997).

The WAG 5 Work Plan (DOE-ID 1997) also called for a gamma detector to log both boreholes to the depth of the anticipated 7.6-m (25-ft) interbed. Instead, gamma logging was completed down to 28.7 m (94 ft) in the first borehole and 10.7 m (35 ft) in the second. The results of the gamma logging indicated an average Cs-137 concentration of 0.38 + 0.03 pCi/g to a depth of 0.9 m (3 ft) bls. No other gamma-emitting radionuclides were detected. Cesium 137 was not detected at depth. The use of a beta detector was not planned or identified in the WAG 5 FSP (DOE-ID 1997), but when one became available, it was used to log the subsurface. The in situ beta measurements were collected starting at a depth of 1.2 m (4 ft) bls (below the well casing) and continuing to the bottom of each borehole. No anthropogenic radionuclides were detected with the in situ beta radionuclide assay system in either borehole (Giles 1997).

A second data gap was the lack of data about the presence and average concentrations of alpha-emitting isotopes and Sr-90. During the 1990 remedial investigation (Stanisich et al. 1992), only one sample was analyzed for alpha isotopes and Sr-90 analysis was not performed. Therefore, potential risks from these contaminants could not be evaluated. The single 1990 sample for alpha analysis was collected in the area with elevated Cs-137 activity and yielded concentrations of Pu-239 and U-234 at the levels of 2.6 and 1.6 pCi/g, respectively. To adequately meet the data need, additional samples were specified for alpha isotopic and Sr-90 analyses in the WAG 5 Work Plan (DOE-ID 1997).

The WAG 5 FSP (DOE-ID 1997) contains a complete description of the surface sampling of the ARA-I Chemical Evaporation Pond (ARA-745). A grid established on 3-m (10-ft) centers was overlain on the site. Nineteen locations were selected at random from the grid, and for each location, sample collection was planned at two depths for a total of 38 samples. When the surveyors marked the sample locations, one sample was located on a basalt outcropping and was moved 15 cm (6 in.). Several other sample locations had very shallow surface sediments, but were successfully sampled without modifying the locations specified in the FSP (DOE-ID 1997). The analytical results for the sampling performed under the Work Plan are presented in Appendix E.

The ARA-01 site was retained for quantitative risk assessment in the comprehensive baseline risk assessment to evaluate the risk from contamination detected in the evaporation pond soils. Detected contaminants include Am-241, Cs-137, Sr-90, U-235, Pu-238, Pu-239/240, Ra-226, arsenic, lead, and thallium.

3.1.2 ARA-02: ARA-I Sanitary Waste Leach Field and Seepage Pit (ARA-746)

The ARA-02 site is a sanitary septic system comprising three septic tanks in series, a seepage pit, and associated piping. The system was built in 1960 and serviced permanent and temporary ARA-I buildings until 1988 when ARA-I was inactivated. The ARA-02 septic system was designed and intended exclusively for sanitary waste. No known process wastes were routed to the system and no recorded spills or documented incidents were associated with the septic system. However, periodic radiological control surveys indicated radiological contamination. The source of the contamination was unknown. As part of a Track 2 investigation (Pickett et al. 1993), soil samples were collected along the main line and outside of the seepage pit and septic tanks. The contents of the tanks, seepage pit, and main line also were sampled. The septic tanks and seepage pit contained listed mixed waste, and low concentrations of contaminants were detected in the soils along the sides of the septic tanks and seepage pit. The soil samples obtained outside the seepage pit showed no RCRA hazardous constituents. Low levels of beryllium, U-234, U-238, and Sr-90 were detected during the Track 2 sampling of the pipeline between the septic tanks and the seepage pit. Samples were not analyzed for gamma-emitting radionuclides. In addition, the liquid levels inside the tanks were observed and found to vary over time, which indicated possible leakage to the soils below (Parsons 1996). On the basis of the risk evaluation, removal of the septic tank contents, confirmation sampling, and a reevaluation of the site in the WAG 5 comprehensive RI/FS were recommended in the Track 2 investigation.

In September 1996, a time critical removal action was implemented at ARA-02 to remove the septic tank contents and to sample the seepage pit interior (Dietz 1998). The contents of all three septic tanks were removed and placed in drums in an approved temporary accumulation area to await final disposition. The sampling information from the 1996 removal action was reviewed and incorporated into the RI/FS.

The status of the integrity of the septic system was the only data gap identified for ARA-02 in the WAG 5 Work Plan (DOE-ID 1997). Further investigation was planned to support site characterization, risk assessment, and the evaluation of remedial alternatives. Because the septic tanks and seepage pit are some distance apart, the risk for the soil surrounding the three septic tanks was evaluated separately from the seepage pit. The pipeline between the structures was not identified as a data gap and not investigated further. The two potential sources and activities to satisfy data needs for the WAG 5 comprehensive RI/FS are addressed below. The sampling data gaps identified in the Work Plan have been filled. The results of the sampling activities conducted under the WAG 5 FSP (DOE-ID 1997) are provided in Appendix E.

3.1.2.1 ARA-02 Septic Tank Soils. Sampling plans for the septic tank soils (DOE-ID 1997) included collecting soil from boreholes drilled beside each of the three septic tanks and sampling the basalt interface. Boreholes were drilled, and samples were obtained from the soils adjacent to the first two septic tanks. Several attempts to drill a borehole next to the third septic tank were unsuccessful. Apparently, the septic tank was blasted into basalt, and the interface was found to be only several feet below land surface. Therefore, samples could be collected only from shallow soils rather than at the base of the tank (Wilson-Lopez 1997).

The ARA-02 septic tank soils were retained for quantitative risk assessment in the comprehensive BRA to evaluate the risk from arsenic, Ra-226, Sr-90, U-234, and U-235 detected in the septic tank soils.

3.1.2.2 ARA-02 Seepage Pit. The seepage pit was the area of greatest concern for soil contamination at ARA-02 because the structure is open to the basalt beneath it. The seepage pit interior was sampled for radionuclides along with the entire list of underlying hazardous constituents as determined by the removal action report during the time critical removal action (Dietz 1998).

The WAG 5 FSP (DOE-ID 1997) contains a complete description of the planned sampling for ARA-02. The nature and vertical extent of contamination beneath the seepage pit was identified as a data gap in the WAG 5 Work Plan (DOE-ID 1997) because previous investigations had encountered bedrock at shallow depths (2.4 to 3 m [8 to 10 ft]), preventing the development of vertical contaminant profiles. Therefore, soil samples for analysis of radionuclides, toxicity characteristic leaching procedure (TCLP) metals, total polychlorinated biphenyls (PCBs), and volatile organics were specified for characterization.

As identified in the WAG 5 FSP (DOE-ID 1997), a location alongside the pit would be chosen for sampling. The construction details for the pit indicated that the top of the pit was 23 cm (9 in.) below the surface, the bottom was 2.4 to 2.9 m (8 to 9.5 ft) below the surface, and the pit bottom had a 20-cm (8-in.) foundation with an opening in its center to allow subsurface drainage. Planned sampling included drilling two boreholes next to the pit to a depth approximating the bottom of the seepage pit, and collecting soil from alongside the seepage pit. Samples were to be collected from depths of approximately 1 to 1.2 m (3.5 to 4 ft) and 2.9 to 3 m (9.5 to 10 ft), and at basalt. If basalt were encountered before reaching either of the first two depths, samples were to be collected at that point. If radioactive contamination were found at the borehole basalt interface, the basalt would be drilled to determine the vertical extent of the contamination.

When the first borehole was drilled approximately 45.7 cm (18 in.) from the side of the seepage pit, samples were collected from the interval at 1 to 1.2 m (3.5 to 4 ft). But samples could not be collected at 2.9 to 3 m (9.5 to 10 ft) because cobble had been used to surround the pit instead of dirt. A clay layer at the basalt interface was too small for an adequate sample (Wilson-Lopez 1997). The drill rig was moved to the opposite side of the seepage pit and a second borehole was attempted, but because of cobble and basalt, no samples could be obtained. The drill rig was moved approximately 0.9 m (3 ft) from the first borehole and 15 cm (6 in.) from the seepage pit wall where the third borehole was drilled, and the clay layer at the basalt interface was thick enough to obtain an adequate sample (Wilson-Lopez 1997).

The original plan, according to the WAG 5 FSP (DOE-ID 1997), states that if radiological contamination were detected at the basalt interface, the borehole would be drilled deeper to determine the vertical extent of the contamination. Radiological control personnel surveyed each sample and each borehole at the basalt interface, and no measurable radioactivity was encountered (Wilson-Lopez 1997).

The ARA-02 seepage pit was retained for quantitative risk assessment in the comprehensive baseline risk assessment to evaluate the risk from contaminants detected in the seepage pit sludge and the seepage pit soils. These contaminants detected in the sludge include arsenic, cadmium, chromium, copper, lead, nickel, silver, Aroclor-1242, diethylether, Ag-108m, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Np-237, Pu-238, Pu-239/240, Ra-226, Sr-90, Tc-99, Th-230, U-234, U-235, and U-238. The contaminants detected in the soils surrounding the seepage pit include arsenic, chromium, copper, lead, nickel, Am-241, Cs-137, Eu-152, Ra-226, U-234, U-235, and U-238.

3.1.3 ARA-03: ARA-I Lead Sheeting Pad Near ARA-627

The ARA-03 site is a contaminated soil area located east of ARA-I building ARA-627. The area was identified as contaminated in 1979 during a routine radiation survey. The source of the contamination is uncertain, but may have originated either from a tank truck parked at the facility or from cleanup operations following the 1961 reactor accident at Stationary Low-Power Reactor No. 1 (SL-1). Lead sheeting was placed over the site for shielding. The sheeting was removed in 1991, and the site was assessed in a Track 2 investigation (Pickett et al. 1993). Risks were identified from direct exposure to Cs-137 at unacceptable levels.

Soil was removed as part of the D&D of ARA-I to a depth of 1.1 m (3.5 ft) in a 7.6 × 7.9-m (25 × 26-ft) area. The approximate total volume of 66 m^3 (84 yd^3) was disposed of at the RWMC. Post-removal sampling and analyses were conducted to determine residual concentrations of Cs-137, other gamma-emitting radionuclides, and selected heavy metals. Cesium-137 was the only detected radionuclide. Concentrations ranging from 0.49 to 7.4 pCi/g were detected in the five locations sampled and averaged 2.9 pCi/g. The background level defined for Cs-137 grab samples is 1.28 pCi/g (Rood, Harris, and White 1996). Concentrations of arsenic ranged from 6.2 to 9.1 mg/kg and averaged 7.8 mg/kg. Compared to the arsenic Site-wide background value for grab samples of 7.4 mg/kg (Rood, Harris, and White 1996), the samples from four of five sample locations yielded slightly higher concentrations. According to Stanisich et al. (1992) and Martin et al. (1990), local background concentrations for ARA and PBF are as higher as 8.3 and 38.7 mg/kg, respectively. Therefore, detected concentrations are consistent with the local WAG 5 background for arsenic. Concentrations of all other heavy metals were below background values. The contaminated soils were packaged in 56 boxes and transported to the RWMC. The site was backfilled and graded with clean soil to a depth of 0.9 m (3 ft) and seeded with grass. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The ARA-03 site was retained for quantitative risk assessment in the WAG 5 comprehensive RI/BRA to evaluate the risk potential from Cs-137.

3.1.4 ARA-04: ARA-I Sewage Treatment Facility (ARA-737)

The ARA-04 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The site consists of the chlorinator enclosure located east of ARA-I and directly north of the ARA-747 septic system. The structure was used to distribute hypochlorite solution into the sewer system from approximately 1955 to 1965. In an assessment of the site performed under the COCA, Hover (1992a) found (1) that the chlorinator facility was separate and isolated from both the chemical waste drainage and the sanitary sewer systems and (2) no potential or identified hazardous waste or radiological contamination at the site. Currently, the enclosure is completely portable with no lines tying it to any other structure.

Because ARA-04 is free of significant contamination from either radiological or hazardous waste constituents, no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997) and the site was not retained for quantitative risk evaluation in the RI/BRA.

3.1.5 ARA-05: ARA-I Evaporation Pond to NE (ARA-744)

The ARA-05 site was originally described in the initial site identification as an evaporation pond northeast of ARA-I. The area is a shallow natural depression that may have received some runoff from an adjacent small parking lot. Anecdotal information indicates that the site was identified for evaluation under the COCA because of some "stressed vegetation." No records of waste generation or disposal processes are associated with this site, no piping or waste lines extend to the pond, nor do any records indicate that the site was ever the destination of any waste stream. Historical monitoring surveys detected the presence of random radioactive particles in both the pond area and the general vicinity around ARA-I and ARA-II. These hot particles are probably a result of the 1961 SL-1 reactor accident and cleanup efforts (DOE-ID 1996). In 1993, the site was prepared for removal of radioactive particles, but the 1993 survey indicated that the area was then free of radioactivity above the ambient background. A record of decision (ROD) (DOE-ID 1996) documenting the determination that no further action is warranted for this Track 1 site was signed in 1996 by DOE-ID, EPA, and the Idaho Department of Health and Welfare (IDHW).

Because ARA-05 is free of significant contamination from either radiological or hazardous waste constituents and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), the site was not retained for quantitative evaluation in the RI/BRA.

3.1.6 ARA-06: ARA-II SL-1 Burial Ground

The ARA-06 site consists of soils and buried waste. The buried waste includes radioactive debris, soils, and gravel from the 1961 SL-1 reactor accident and cleanup (Holdren, Filemyr, and Vetter 1995). The SL-1 Burial Ground, located about 488 m (1,600 ft) northeast of ARA-II, contains approximately 2,800 m^3 (99,000 ft^3) in three excavations within a fenced impoundment 183 m long and 91 m wide (600 × 300 ft). The site was to have been evaluated initially with a Track 2 investigation (DOE-ID 1991), but it was determined that sufficient information existed to conduct a streamlined RI/BRA. During the 1991 RI/FS, risks were quantified without additional sampling or the preparation of a work plan. Instead, a computer model was used to simulate the inventories of radionuclides resulting from the 1961 SL-1 reactor accident (Holdren, Filemyr, and Vetter 1995). External exposure to Cs-137 was identified as the primary risk driver. Risks for the 100-year future residential intrusion scenario were estimated at 1E-01 for direct exposure, 2E-04 for soil ingestion, 4E-07 for dust inhalation, and 1E-06 for groundwater ingestion (Holdren, Filemyr, and Vetter 1995). Containment by capping with an engineered barrier constructed primarily of natural materials was identified as the selected remedial alternative in the ROD for the site (DOE-ID 1996). This alternative was based on the assumption that the capping action would sufficiently mitigate unacceptable risks from external exposure, soil ingestion, and dust inhalation. As documented in the ROD (DOE-ID 1996) the boundary of ARA-06 was expanded outward from the SL-1 Burial Ground perimeter fence to include approximately 40% of ARA-23. Based on dose equivalent rates (Jorgensen 1995), no unacceptable risks were identified for this area. Remedial actions specified in the ROD (DOE-ID 1996) excluded all soils outside of the SL-1 Burial Ground fence. During the 1997 global positioning radiometric scanner (GPRS) survey, Cs-137 was detected at levels in excess of 23 pCi/g.

In 1996, a remedial design/remedial action (RD/RA) was implemented at ARA-06 (Parsons 1997). The RD/RA consisted of sampling on an established grid inside the SL-1 Burial Ground perimeter fence, and surface soils with contamination greater than 16.7 pCi/g of Cs-137 were consolidated over the pits and trench before placement of the engineered barrier. The engineered barrier has two components: (1) a biotic barrier and (2) a human intrusion barrier. The biotic barrier consists of cobble between two layers of pea gravel that will inhibit intrusion of insects and small burrowing animals. The human intrusion barrier consists of large (61-cm [24-in.]) basalt boulders. A chain-link fence with a gate and granite monuments engraved with universal warning symbols were erected at the site.

No sampling data gaps were identified for ARA-06 in the WAG 5 Work Plan (DOE-ID 1997). The ARA-06 site was not retained for quantitative risk analysis in the comprehensive RI/BRA because the potentially unacceptable risks at the site to workers and future residents, which were identified in the RI/FS (Holdren, Filemyr, and Vetter 1995), were mitigated by the remedial action. The groundwater risks, estimated at 1E-06 in the RI/FS, were further evaluated in a sensitivity study (see Magnuson and Sondrup 1998 in Appendix J). The worst-case risk estimate for groundwater ingestion was less than 2.0E-06. The contaminated soils outside of the Burial Ground fence will be addressed in the RD/RA as part of ARA-23.

3.1.7 ARA-07: ARA-II Seepage Pit to East (ARA-720A)

The ARA-07 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The inactive concrete block-lined seepage pit has a diameter of 4 m (13 ft), a depth of 3 m (10 ft), and a gravel base. The seepage pit lies just outside the ARA-II facility fence and was the terminus of two septic tanks

servicing buildings within ARA-II and an underground waste detention tank (ARA-719). The system was in use from approximately 1959 to 1986. In an assessment of the site performed under the COCA, Hover (1992b) found no evidence that the pit had received hazardous waste. Samples were scraped from stained areas on the block walls and composited with gravel collected from the base of the seepage pit below each drain. Gamma isotopic analysis of the composite sample indicated a Cs-137 concentration of 17.6 pCi/g (Meyer 1992), which exceeds the INEEL background concentration for Cs-137 in surface soil. The elevated Cs-137 concentration may be related to the 1961 SL-1 accident and subsequent cleanup. Samples were analyzed for metals, and all detections were significantly less than regulatory levels (Meyer 1992). No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997).

The ARA-07 site was assessed and determined to be free of significant contamination from hazardous waste constituents. Any residual soil contamination will be addressed as part of the RD/RA for ARA-23. Therefore, the site was not retained for quantitative risk evaluation in the RI/BRA.

3.1.8 ARA-08: ARA-II Seepage Pit to West (ARA-720B)

The ARA-08 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The inactive seepage pit has a diameter of 4 m (13 ft), a depth of 3 m (10 ft), and a gravel base. The seepage pit was the terminus of a waste line from the Administrative and Technical Support Building (ARA-606) septic tank and lies outside the facility fence. The system was in use from approximately 1959 to 1986. In an assessment of the site performed under the COCA, Hover (1992c) found no evidence that the pit had received hazardous waste. Radiological and chemical analyses of sediment samples collected from the seepage pit in 1991 showed Cs-137 concentrations of 7.49 to 11.6 pCi/g (Meyer 1992). The Cs-137 concentration is slightly elevated compared to the INEEL background level for CS-137 in surface soils and may be related to the 1961 SL-1 accident and subsequent cleanup. No other constituents were detected above regulatory levels. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997).

The ARA-08 site was assessed and determined to be free of significant contamination from hazardous waste constituents. Any residual soil contamination will be addressed in the RD/RA for ARA-23. Therefore, the site was not retained for quantitative risk evaluation in the RI/BRA.

3.1.9 ARA-09: ARA-II Septic Tank (ARA-738)

The ARA-09 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The 1,500-gal septic tank was one of two septic tanks servicing buildings within ARA-II. The system was in use from approximately 1959 to 1986. In an assessment of the site performed under the COCA, Hover (1992d) found no evidence that the pit received hazardous waste. The tank was sampled in 1991. Two samples each were taken of the liquid phase and of the sludge. Radiological analysis of the samples detected Cs-137 in a concentration of 51.8 pCi/g in the sludge. No gamma isotopes were detected in the liquid phase. Chemical analysis of these samples indicated concentrations below regulatory levels (Meyer 1992). The septic tank and sludge were removed during 1994 D&D activities; therefore, any potential release of contamination from the septic tank was eliminated. The radiological survey performed before excavation was 400 counts above background (Anderson 1994). As the tank was removed, some corrosion was observed on the tank apex, but there was no evidence that the tank had leaked. After the tank was removed, the radiological survey from the bottom of the excavation was 200 counts above background (Anderson 1994). The only constituents detected above background concentrations in post-removal soil samples were essential nutrients.

The site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). Therefore, the site was not retained for quantitative risk evaluation in the RI/BRA.

3.1.10 ARA-10: ARA-II Septic Tank East (ARA-613)

The ARA-10 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The 500-gal underground tank received sanitary waste from the Administration Building (ARA-613) and a temporary trailer. The system was in use from approximately 1959 to 1986. In an assessment of the site performed under the COCA, Hover (1992e) found no evidence that the tank received hazardous waste. In 1991, the tank was found empty except for a rusty, scale-like residue. Radiological and chemical analyses of two residue samples collected in 1991 indicated Cs-137 concentrations of 304.0 and 341.0 pCi/g, and Co-60 concentrations of 0.11 and 0.156 pCi/g (Meyer 1992). No other constituents were detected above regulatory levels. The septic tank was removed during D&D activities in 1995 and disposed of at the RWMC; therefore, any potential environmental contamination from the septic tank was eliminated. However, two data needs were identified in the WAG 5 Work Plan (DOE-ID 1997). One data need was to determine whether the tank had leaked, and if so, the vertical extent of contamination. The other data need was to determine the presence and concentration of gamma-emitting radionuclides in the subsurface soils.

According to the WAG 5 FSP (DOE-ID 1997), which contains a complete description of the planned sampling of the ARA-II Septic Tank, one sample would be collected from the subsurface soils underlying the former location of the septic tank. A borehole would be drilled down to 2.4 m (8 ft), and a sample would be collected from 2.4 to 3 m (8 to 10 ft) for gamma-spectrometric analysis. If field screening showed radioactivity above background levels for this sample, the borehole would be extended and samples would be collected every 61 cm (2 ft) until field screening no longer showed radioactivity levels above background.

When the WAG 5 FSP (DOE-ID 1997) was prepared, it was believed that northing and easting coordinates were available for the historic location of the septic tank and that the tank had been completely buried. Instead, no coordinates could be obtained for the historic location of the tank. Surveyors were called in to assist. They reviewed the ARA-II facility drawings and were able to triangulate the historic location of the tank within ± 2 ft. When the borehole was drilled at this location, it was discovered that the tank was not buried as deeply as expected, and basalt was only 2.1 m (7 ft) bls. When the tank was removed in 1995 by D&D, the area was reported to have been excavated to approximately 2.4 m (8 ft) bls. Samples were taken in the soil that had been below the tank. No samples showed radioactivity above background (Wilson-Lopez 1997). Therefore, the borehole was not extended.

The sampling data gaps identified in the WAG 5 Work Plan (DOE-ID 1997) have been filled, and the results of laboratory analyses are presented in Appendix E. The ARA-10 site was assessed and because no contaminants were identified above background concentrations, the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.11 ARA-11: ARA-II Septic Tank West (ARA-606)

The ARA-11 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The 500-gal underground septic tank received sanitary waste from the Administrative and Technical support Building (ARA-606). The system was in use from approximately 1959 to 1986. In an assessment of the site performed under the COCA, Hover (1992f) found no evidence that the tank received hazardous

waste. Samples of the sludge and liquid phases of the tank contents were collected in 1991. Radiological and chemical analyses indicated Cs-137 concentrations of 4.67 and 4.45 pCi/g, and no other constituents were detected above regulatory levels. The septic tank was removed during D&D activities in 1995, eliminating potential environmental contamination from the septic tank. The site was assessed as free of significant contamination from either radiological or hazardous waste constituents. Any residual surface soil contamination will be addressed as part of the RD/RA for ARA-23. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.12 ARA-12: ARA-III Radioactive Waste Leach Pond

The ARA-12 site is an unlined surface impoundment constructed in a natural depression west of ARA-III across Wilson Boulevard. The ARA-III facility was an active reactor research facility from about 1959 to 1965. The pond was constructed to receive low-level liquid waste from reactor research operations. Liquid waste was stored temporarily in tanks, then transferred to the leach pond via an underground pipe. Effluent contained chromium, used in solutions to inhibit algae growth, and minute amounts of low-level radioactive material. A second, separate line to the leach field originated in an uncontaminated water storage tank (ARA-709). A third source of effluent was facility runoff via a culvert. From 1966 to 1987, activities at ARA-III were limited to component and instrumentation testing, instrumentation development and fabrication, and chemical research. No known waste was disposed of in the leach pond associated with these activities. In 1991, the culvert was plugged in preparation for D&D operations at ARA-III. The tanks and waste lines to the leach pond were removed in 1993 during the D&D of ARA-III.

A Track 2 evaluation was initiated in 1993 and completed in 1994 (Pickett et al. 1994). Radiological and topographical surveys were performed, and soil samples were collected and analyzed. The outer dimensions of the pond were estimated as 115 × 50 m (377 × 164 ft). A smaller area of approximately 21 × 61 m (69 × 200 ft), which received the majority of the wastewater, still contained remnants of enhanced vegetation. The 1993 data were combined with historical information to evaluate nonintrusive 100-year future residential and current occupational default exposure scenarios defined in Track 2 guidance (DOE-ID 1994). Future residential intrusive and future occupational scenarios were not assessed. Evaluated contaminants included Ag-108m, Cs-137, U-235, Am-241, Co-60, Pu-238, U-234, chromium, cadmium, lead, and Aroclor-1254. A total risk of 2E-03 and a hazard index of 0.3 were estimated for the 100-year future residential nonintrusion scenario using default parameters. The risk from direct exposure is 2E-03 and is primarily from Ag-108m, Cs-137, and U-238. The entire 0.3 hazard index is associated with the groundwater ingestion of cadmium and chromium. For the current occupational scenario, a total risk of 1E-03 was estimated. The primary risk drivers were identified as Ag-108m, Co-60, and Cs-137 in the direct exposure pathway and chromium in the inhalation of fugitive dust pathway.

Following review of the Track 2 evaluation, DOE-ID, the EPA, and IDHW concurred that the site should be evaluated in an RI/FS. However, no sampling data gaps were identified for ARA-12 in the WAG 5 Work Plan (DOE-ID 1997). The ARA-12 site was retained for quantitative risk analysis in the comprehensive RI/BRA to evaluate the risk from chromium, lead, manganese, Ag-108m, Am-241, Co-60, Cs-137, Pu-238, U-234, and U-238. The ARA-12 site also was retained on the basis of in situ Cs-137 data obtained with the GPRS (see Section 3.1.15). The GPRS was used to survey the ARA-12 site as part of the ARA-24 in situ gamma survey to enhance understanding of the contamination at ARA-12. When the data from the GPRS were analyzed, Cs-137 concentrations greater than 45 pCi/g were indicated for an area just west of the ARA-12 site boundary (see Section 4). Because the area is debris-filled and nearly inaccessible to the GPRS, a germanium spectrometer (Ge-spectrometer) was

deployed to determine the extent of the contamination. When the extent of contamination is known, the ARA-12 site boundary will be expanded.

3.1.13 ARA-13: ARA-III Sanitary Sewer Leach Field and Septic Tank (ARA-740)

The ARA-13 site consists of a septic tank, a distribution box, and a drain field. Sanitary waste was disposed of into the system from 1969 to 1980. Between 1980 and 1983, in addition to sanitary waste, small quantities of laboratory waste were diverted to this system. Sampling and analysis yielded low-level concentrations of arsenic, barium, beryllium, mercury, nickel, selenium, and thallium in four samples taken from the leach field (Pickett and Spry 1991). The metals were detected at depths from 0.3 to 1.8 m (1 to 6 ft). However, concentrations were lower than background metal concentrations (Rood, Harris, and White 1996). The ROD (DOE-ID 1996) documenting the determination that no further action is warranted for this Track 1 site was signed by DOE-ID, EPA, and IDHW in 1996. The site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The ARA-13 site was not retained for quantitative risk analysis in the RI/BRA.

3.1.14 ARA-14: ARA-III Septic Tank and Drain Field (ARA-739)

The ARA-14 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The ARA-14 consists of a 1.8 × 1.8 × 3.1-m (6 × 6 × 10-ft) rectangular concrete septic tank and an approximately 9.1 × 21-m (30 × 70-ft) open-jointed tile drain field. The system received sanitary waste from the Control Building (ARA-607) from approximately 1959 to 1989. In an assessment of the site performed under the COCA, Hover (1992g) found no evidence that the system received hazardous waste. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The tank was removed by the D&D program in 1996, and the waste is currently in an approved temporary accumulation area at the ARA-III facility under the control of the Inspector General. Documentation is being developed by D&D personnel to sample the drummed waste in storage. Because the tank and waste have been removed and there is no evidence that the tank ever leaked, the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.15 ARA-15: ARA-III Radionuclide Tank (ARA-735)

The ARA-15 site is the historical location of a 37,854-L (10,000-gal) stainless steel storage tank designated ARA-735. The tank was encapsulated in an earthen berm along with two other storage tanks (ARA-736 and ARA-708). Installed about 1958, the tank was used to support reactor research operations until 1965. Though the tank was designated as a high-level waste tank, records indicate that only low-level waste was stored in the tank. As part of the D&D of ARA-III, all three tanks, ARA-735, -736, and -708, and their associated piping were examined and removed in 1993, and the earthen berm was leveled. The tanks were empty, dry, and in excellent condition with no observable indications of deterioration or leakage. The ARA-735 tank was decontaminated and excessed for possible reuse. Radiological surveys of the tank exterior and surrounding soils confirmed that the site was not contaminated (LMITCO 1994a). The ARA-15 site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was not retained for quantitative risk analysis in the RI/BRA.

3.1.16 ARA-16: ARA-I Radionuclide Tank (ARA-729)

The ARA-16 site is a 3,785-L (1,000-gal) stainless steel underground holding tank resting within a lidless concrete vault and covered by approximately 1.1 m (3.5 ft) of soil. The ARA-I facility was formally shut down in 1988, and the tank was partially excavated. All lines into and out of the tank were cut and capped, and the contents of the tank were agitated and pumped out, leaving approximately 8 cm (3 in.) or 109 L (28 gal) of liquid and sludge (see Holdren 1998 in Appendix J). Samples were collected and analyzed, two for metals, one for sulfate, and one for volatile organic compounds (VOCs). Through sampling results and anecdotal information, the waste was identified as containing F-listed mixed waste along with transuranic elements. Soil surveys conducted during the partial excavation indicated beta-gamma rates between 400 to 1,000 disintegrations per minute (see Holdren 1998 in Appendix J). Soils from the excavation were replaced over the tank. As identified in the WAG 5 Work Plan (DOE-ID 1997), to adequately characterize the contents of the tank, additional sampling was necessary.

Four separate potential contamination areas or sources are associated with the ARA-I radionuclide tank: (1) the tank contents, (2) the surface and subsurface soil and gravel inside the concrete vault, (3) the concrete itself, and (4) the surface and subsurface soil outside the concrete vault within the 9.1 × 9.1-m (30 × 30-ft) fenced area. Sampling strategies were developed for each potential contamination area except for the concrete. To sample the concrete would have required destructive techniques that would have compromised the integrity of the vault. The sampling data gaps identified in the WAG 5 Work Plan (DOE-ID 1997) have been filled as summarized below. The ARA-16 site was retained for quantitative risk analysis in the RI/BRA to evaluate the risk potential from chloride, sulfate, Ag-108m, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Ra-226, and Sr-90.

3.1.16.1 ARA-16: Interior Sampling of ARA-I Radionuclide Tank Contents. The ARA-16 site contains a 3,785-L (1,000-gal) stainless steel underground radioactive waste holding tank. From 1959 to 1988, the tank received radioactive liquid waste, including wash water from the ARA-I hot cells, and methanol, acetone, chlorinated paraffin, and mixed acids from materials testing and research and metal-etching processes. Periodically, the contents of the tank were emptied into a tank truck and transported to the Idaho Nuclear Technology and Engineering Center (INTEC) for disposal on an as-needed basis as defined by the level in the tank.

The WAG 5 FSP (DOE-ID 1997) contains a complete description of the planned sampling of the interior of the ARA-I radionuclide tank. Because the 1988 sampling agitated the tank contents before sampling, the two layers (phases) of tank contents had to be sampled individually to fully characterize the tank. The original plan as identified in the FSP was to take discrete liquid and sludge samples, but the tank contained more liquid and less sludge than anticipated (Wilson-Lopez 1997). All samples that were planned for in the FSP, except the physical property samples, were obtained. The results are presented in Appendix E. In accordance with the risk assessment protocol (LMITCO 1995), the contents of the tank were not quantitatively evaluated in the RI/BRA.

3.1.16.2 ARA-16: Surface and Subsurface Soil and Gravel Inside the Concrete Vault. A conclusion of the Track 1 investigation (see Holdren 1998 in Appendix J) was that the surface and subsurface soil and gravel inside the concrete vault at the ARA-16 site were contaminated because of possible leaks and spills during pumping or filling operations. It was not known whether the tank itself had leaked. The FSP for the WAG 5 Work Plan (DOE-ID 1997) contains a complete description of the planned sampling. The original plan was to drill a borehole within each of the four corners of the concrete vault to the bottom and to collect samples from the top and bottom of each borehole. In addition, a surface sample was to have been collected from the tank center, but when the drill rig was mobilized to begin drilling between the tank and vault, there was concern that either the vault or the tank might be damaged during drilling. Instead, four boreholes were drilled using a hand auger, and samples

were taken at the vault bottom. When radiological control personnel field surveyed the samples, the readings showed no radionuclides above background. The samples were sent for laboratory analysis, and the results are presented in Appendix E (Wilson-Lopez 1997).

3.1.16.3 ARA-16: Surface and Subsurface Soil Outside the Concrete Vault. Though this entire area was known to have been contaminated by the 1961 SL-1 reactor accident and cleanup (Jorgensen 1995), whether contamination had migrated through the ARA-16 vault was not known. The original plan was to drill four boreholes along the outside of the concrete vault at the ARA-16 site, one per side, down to basalt. Samples were to be taken from depths at 15 cm (6 in.) and at 4.6 m (15 ft) or the basalt interface, whichever came first (DOE-ID 1997).

When the drill rig was used to drill alongside the vault, it appeared that the basalt had been blasted for the placement of the tank, and the concrete for the vault had been poured using the basalt as a mold for the setting of the concrete. Several attempts were made to drill alongside the vault using the drill rig. Three boreholes were successfully drilled, and samples were obtained from 0 to 15 cm (6 in.) on all boreholes as planned. But the first successful borehole was drilled to a depth of only 1.5 m (5 ft) and was sampled at the bottom. The second successful borehole was drilled to a depth of 2.6 m (8.5 ft). The third borehole was drilled with a hand auger to a depth of 3.1 m (10 ft). The second and third boreholes were the only locations from which samples were retrieved below the elevation of the bottom of the vault. Radiological control personnel surveyed each sample, and no measurable radioactivity was encountered (Wilson-Lopez 1997). The samples were sent for laboratory analysis, and the results are presented in Appendix E. Because it appears that the soil contamination is not from the ARA-16 tank, the contaminated soils will be addressed as part of the RD/RA for ARA-23.

3.1.17 ARA-17: ARA-I Drain (ARA-626)

The ARA-17 site is a nearly flat drainage area south of ARA-I that received drainage from two sources: (1) the boiler room blowdown from the Hot Cells building (ARA-626) and (2) the raw water storage tank and pumphouse at the southwestern corner of the facility. The surface dimensions are approximately 46 × 46 m (150 × 150 ft). No concentrations of radiological contamination are above background levels at this site, as confirmed by radiological surveys, and there is no evidence of nonradiological constituents (EG&G April 1993a). Historical documents and process information pertinent to ARA-I do not indicate that this site was the intended destination of any waste stream except uncontaminated water (EG&G April 1993a). The ARA-17 site was assessed as free of contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was not retained for quantitative risk analysis in the RI/BRA.

3.1.18 ARA-18: ARA-III Radionuclide Tank (ARA-736)

The ARA-18 site is the historical location of a 37,854-L (10,000-gal) carbon steel, low-level waste storage tank designated ARA-736. The tank was encapsulated in an earthen berm along with two other storage tanks (ARA-735 and ARA-708) installed about 1958 and used to support reactor research operations until 1965. As part of the D&D of ARA-III, all three tanks and the associated piping were examined and removed in 1993, and the earthen berm was leveled. The tanks were empty, dry, and in excellent condition with no observable indications of deterioration or leakage. Radiological surveys of the tanks' exterior and surrounding soils confirmed that the site was not contaminated (LMITCO 1994b). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE ID 1997). The ARA-18 site was not retained for quantitative risk analysis in the RI/BRA.

3.1.19 ARA-19: ARA-II Detention Tank for Fuel Oil/Radionuclides (ARA-719)

The ARA-19 site, which is one of six sites in OU 5-01, is the historical location of a 3,785-L (1,000-gal) underground radionuclide detention tank. The tank received liquid waste from the chemistry laboratory in ARA-602 from 1953 to 1961. It also was used to store radioactively contaminated fuel oil from the 1961 SL-1 reactor accident and cleanup. The contents of the tank were sampled, analyzed, and identified as radioactively contaminated fuel oil (EG&G April 1992). Approximately 3,785 L (1,000 gal) of waste were removed, placed in drums, and shipped for treatment or disposal. The tank and piping were removed during D&D activities and shipped to the Waste Experimental Reduction Facility (WERF) for additional size reduction and eventual disposal at the RWMC. Soil samples showed concentrations above background values for Cs-137, Sr-90, and Th-230/U-234, and detectable amounts of U-234 below background concentrations also were indicated. Field observations indicated that the tank was in good condition, and no stained soils or other evidence indicated that the tank had ever leaked. Therefore, the residual soil contamination was not attributed to tank operations. The ARA-19 site was assessed as free of significant contamination from either radiological or hazardous waste constituents from the tank, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The ARA-23 contaminated soil site encompasses ARA-19. Any residual soil contamination associated with ARA-19 will be addressed as part of the RD/RA for ARA-23. The ARA-19 site was not retained for quantitative risk analysis in the RI/BRA.

3.1.20 ARA-20: ARA-IV Test Area Contaminated Leach Pit No. 1

The ARA-20 site is the historical location of the terminus of the contaminated waste system at ARA-IV that was active from 1959 to 1970. The pit, constructed of concrete blocks and a cap, was between 3 and 4 m (10 and 13 ft) in diameter and approximately 5.5 m (18 ft) deep. Contaminated wastewater from the ARA-IV mechanical equipment room in ARA-616 was routed to a waste sump, then to a waste storage tank, and then to the leach pit. The pit structure, with the exception of the base ring located 5.5 m (18 ft) below the surface, was removed in 1983 when the ARA-IV facility underwent D&D. In 1993, the site was subjected to a Track 2 evaluation using the 1983 D&D characterization data. Radionuclides were the only contaminants of concern. Before D&D, one sample location showed concentrations above background for U-234 at 7.8 pCi/g; Co-60 at 735 pCi/g; and Ag-108m at 11.63 pCi/g. Post-removal confirmation samples indicated that the site was clean with the exception of one sample that yielded a trace concentration of the PCB Aroclor-1260 (0.17 mg/kg). The hole was filled with clean soil and contoured to match the surrounding terrain (Pickett et al 1994). Because the site was assessed, no unacceptable risks were identified and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). Therefore, the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.21 ARA-21: ARA-IV Test Area Septic Tank and Leach Pit No. 2

The ARA-21 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The 3,785-L (1,000-gal) underground septic tank and leach pit received sanitary waste from the ARA-IV Test Area Building (ARA-616). The system was used from approximately 1957 to 1970. During D&D operations in 1987, all pipes to the system were removed and the septic tank and leach pit were covered with 1.4 m (4.5 ft) of soil. In an assessment of the site performed under the COCA, Hover (1992h) reported that no evidence of significant chemical or radiological contamination was found based on sampling conducted under the D&D program in 1987. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.22 ARA-22: ARA-IV Control Area Septic Tank and Leach Pit No. 3 (ARA-617)

The ARA-22 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The sanitary system receives waste from the ARA-IV Control Area Building (ARA-617). The system has been active since 1959, is still in use, and presently receives only sanitary waste. In an assessment of the site, Hover (1992i) reported that the sanitary system was characterized in 1987 through the D&D program and no evidence of contamination was found. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.23 ARA-23: Radiologically Contaminated Surface Soils Around ARA-I and ARA-II

The ARA-23 site is one of the seven sites assigned to the WAG 5 comprehensive RI/FS, OU 5-12. The ARA-23 site is a large, roughly oval-shaped windblown contamination site encompassing the SL-1 Burial Ground and the remnants of the ARA-I and ARA-II facilities. The long axis of the site is consistent with the generally southwest to southeast winds common on the INEEL. Soils were radiologically contaminated by the 1961 SL-1 accident and subsequent cleanup. Minor amounts of contamination may have been added by other ARA operations. Over time, winds dispersed the contamination over an area roughly 100 hectares (240 acres) in size.

A Track 1 investigation was initiated for the site in 1993 but not finalized because the site was reassigned to OU 10-06 for evaluation. The OU 10-06 evaluation, which excluded the areas within the ARA-I and ARA-II facility fences, was only partially completed before the site was reassigned to WAG 5 for final disposition. The site was originally defined as the subsurface structures (e.g., reactor building foundation and underground utilities), soil contamination within the ARA-I and ARA-II facility fences, and all radiologically contaminated surface soils surrounding the ARA-I and ARA-II facilities as defined by an aerial survey isopleth (Jorgensen 1995). As documented in the OU 5-05 ROD (DOE-ID 1996) the boundary of ARA-06 was expanded outward from the SL-1 Burial Ground perimeter fence to include approximately 40% of ARA-23. Based on dose equivalent rates (Jorgensen 1995), no unacceptable risks were identified for this area. Remedial actions specified in the ROD (DOE-ID 1996) excluded all soils outside of the SL-1 Burial Ground fence. During the 1997 GPRS survey, Cs-137 was detected at levels in excess of 23 pCi/g. Therefore, the soils outside of the Burial Ground fence will be addressed as part of the RD/RA for ARA-23.

Data gaps were identified for the ARA-23 site in the WAG 5 Work Plan (DOE-ID) 1997. The data gaps were the horizontal and vertical extent of Cs-137 greater than 16.7 pCi/g in the shallow soil, and the presence of other radionuclides such as Co-60, Eu-152, Eu-154, Sr-90, and uranium isotopes. The Work Plan contains a complete FSP for sampling ARA-23. To fill the data gaps identified in the Work Plan, historical sample data from surface soils at ARA-23 were interpolated (i.e., kriged) to generate concentration isopleths. The extent of the Cs-137 surface contamination appeared to be well defined by the kriging. Verification sampling was planned for 19 approximately equally spaced locations along the 10 pCi/g isopleth for Cs-137. Samples were collected at 0 to 15 cm (0 to 6 in.) and 15 cm to 0.6 m (6 in. to 2 ft) for a total of 38 samples. The analytical results are presented in Appendix E. Analytes include Am-241, Cs-137, Ra-226, Sr-90, Th-230, and U-235.

In addition to soil sampling, the WAG 5 FSP (DOE-ID 1997) specified a surface gamma-radiation survey at ARA-23 to determine the approximate lateral extent and concentrations of Cs-137. A statistically designed sampling grid would be prepared for the survey based on the soil sampling results, and a sodium iodide scintillation detector would be deployed to survey along the grid lines. If an increase in the instrument reading were encountered, the grid location would be flagged and the site coordinates

surveyed, which would enable the project to construct an isopleth map based on the surveyed counts per minute.

The WAG 5 FSP (DOE-ID 1997) specified the surface gamma radiation survey using a hand-held sodium iodide scintillator, but to reduce labor, the surface gamma radiation survey was performed using two types of in situ detectors: a global positioning radiometric scanner and a germanium spectrometer (Josten 1997). The GPRS was used to survey areas accessible by vehicle. The Ge-spectrometer, a hand-held gamma instrument, was used for areas requiring walk-over survey techniques. The GPRS consists of a large-area plastic scintillation detector mounted on the front of an all-terrain vehicle equipped with a global positioning navigation instrument. The scintillation detector is mounted permanently to maintain a constant detector to ground distance of 1 m (3.3 ft). At this elevation, the scintillation detector has a diameter field of sensitivity of approximately 7.6 m (25-ft). Scintillator and global positioning system (GPS) position data were collected continuously at approximately 2-second intervals during the site survey, with the instrument moving at an average speed of 2.5 mph. The gamma-ray field intensity from the GPRS was recorded in counts per second (cps). Approximately 69,000 in situ gamma-radiation measurements were collected. The highest cps value recorded at the site was 117,961 cps.

Eighty-eight measurements were taken with the second type of in situ detector, the Ge-spectrometer, at a rocky, debris-filled area that was inaccessible to the GPRS, and 14 measurements were taken at a selected set of calibration points. The Ge-spectrometer was mounted on a tripod that maintained a constant detector-to-ground distance of 1 m (3.3 ft). At this elevation, the Ge-spectrometer had approximately the same 7.6 m (25-ft) field of sensitivity as the GPRS.

Data from the GPRS survey and the Ge-spectrometer were combined into a common database, and maps were compiled showing position, data-point distribution, bulk gamma radiation, and Cs-137 concentrations. These data, combined with the analytical results presented in Appendix E, satisfy the data gap identified in the Work Plan for ARA-23.

The ARA-23 site was retained for quantitative risk assessment in the comprehensive BRA to evaluate the risk potential from Am-241, Cs-137, Ra-226, Sr-90, Th-230, and U-235 detected in the soils. The site also was retained for qualitative risk evaluation of Cs-137 data obtained with the GPRS. Because ARA-23 encompasses the ARA-I and ARA-II facilities and the SL-1 Burial Ground, 15 other sites (i.e., ARA-01, -02, -03, -04, -05, -06, -07, -08, -09, -10, -11, -16, -17, -19, -25) fall within the boundaries of the windblown contamination area as originally defined. Several of these sites were retained for quantitative analysis in the RI/BRA. Others were eliminated from further evaluation. However, residual soil contamination at these 15 sites probably was generated by the same sources as the ARA-23 contamination. Therefore, all residual soil contamination in ARA-23 not specifically addressed for another individual site will be addressed as part of the RD/RA with ARA-23.

3.1.24 ARA-24: ARA-III Windblown Soil

The ARA-24 site consists of the surface soils surrounding the ARA-III facility, as defined by a 1990 aerial survey, excluding Site ARA-12 and including the area within the ARA-III facility fence. Nearly all ARA-III structures have been removed.

Historically, only three samples have been collected and analyzed for Cs-137 and one sample for actinides at ARA-24. Therefore, a data gap need was identified in the WAG 5 Work Plan (DOE-ID 1997) to determine the horizontal and vertical extent of Cs-137 contamination and the presence of other radionuclides.

The WAG 5 FSP (DOE-ID 1997) contains a complete description of the planned sampling for ARA-24. According to the FSP, the sampling strategy would, if necessary, consist of three phases. In the first phase, a grid would be laid out and sodium iodide detectors would be used to survey the site for gamma emitters beginning at the southern boundary of the gridded area and proceeding north. At each 50-cps increase or decrease above background, the location would be staked and the counts per second would be noted on the stake. The results would be used to develop an isopleth map based on counts per minute. The second phase of the sampling would be performed only if contamination above background were indicated by the field survey results. In the second phase, a statistically based analysis of the field-screening results would determine the number of soil samples necessary to define the correlation between the field-screening results and laboratory gamma-spectroscopic results. The result of this correlation would be the development of an actual concentration isopleth map. If a correlation between the field-screening results and gamma-spectroscopic results could not be determined, additional soil samples would be obtained for gamma-spectroscopic analysis to strengthen the correlation study and provide data for the concentration isopleth map. If the second phase indicated minimal detections, the sampling would conclude with this phase. Otherwise, the third phase would commence using ranked-set sampling.

According to the FSP, a surface gamma-radiation survey would be performed using a hand-held sodium iodide scintillator. But because of the labor-intensive effort, the surface gamma-radiation survey was performed using the GPRS described in Section 3.1.15. Approximately 13,000 in situ gamma-radiation measurements were collected at ARA-24 (Josten 1997).

Data from the GPRS survey were used to compile maps showing the data-point distribution, bulk gamma radiation, and the Cs-137 concentrations. The data indicated that no areas within the ARA-24 site boundary were above background (Josten 1997); therefore, the second and third sampling phases as identified in the WAG 5 FSP were not conducted because the data gaps identified in the WAG 5 Work Plan have been filled (Josten 1997). The ARA-24 site was retained for quantitative risk assessment in the comprehensive baseline risk assessment to evaluate the risk potential from Pu-238 contamination detected in the soils.

3.1.25 ARA-25: ARA-I Soils Beneath the ARA-626 Hot Cells

The ARA-25 site was identified during the final development of the WAG 5 comprehensive RI/FS and recently added to the FFA/CO Action Plan (DOE-ID 1991). As part of the ongoing D&D activities at ARA I, radiologically contaminated concrete floor slabs were cut out of the ARA-626 Hot Cells (Cells No. 1 and No. 2). Because the concrete was poured directly on the soil, the undersides of the slabs (about 6-in. thick) were covered completely with soil. In a radiological evaluation of the soils that sloughed off the underside of the concrete slabs and on the rebar protruding from the concrete, the initial contamination levels of 50,000 disintegrations per minute were identified. However, this determination was difficult to verify because of the radiological interference generated by the tops of the hot cell floor slabs.

The floor drains and accompanying drain lines in the hot cells were connected into the hot cell floors through welding to the carbon steel floor cladding. At one time, stainless steel piping connected these drains to the ARA-729 hot waste tank (ARA-16 site). The ARA-729 tank contains PCB-contaminated, listed mixed waste and transuranic radionuclides. Six other drain lines also were connected to the ARA-729 tank. These other lines are from the decontamination room, the service area, the hot metallurgy area, a hot laboratory (Room 125), and two isolation areas. The isolation areas were located immediately behind the hot cells and were used for initial decontamination of equipment removed from the cells and also for repair and modification of equipment.

In 1998, the hot cells were removed by D&D and the soils and concrete floor slab were sampled. Three samples were taken of the soil where the floor drains had been located, and three samples were taken of the concrete. After sampling, a fixative was applied to the soils exposed under the concrete slabs and the roof of Building ARA-626 was placed over the entire area for shielding.

The analytical results for the sampling performed by D&D are presented in Appendix L. The ARA-25 site was retained for quantitative risk assessment in the comprehensive baseline risk assessment to evaluate the risk from contamination detected in the soils. The contamination from the concrete was not evaluated for risk since the concrete will be removed as part of the remediation of WAG 5. Detected contaminants retained for human health risk evaluation include arsenic, copper, lead, manganese, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Ra-226, Sr-90, and U-235.

3.1.26 PBF-01: PBF Control Area Septic Tank (PBF-724), Seepage Pit (PBF-735)

The PBF-01 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The 3,785-L (1,000-gal) underground septic tank and associated seepage pit receives sanitary waste from the PBF Control Area Electrical Maintenance Building (PBF-619). The system has been active since 1967, is still in use, and presently receives only nonradiological, nonhazardous sanitary discharges. In an assessment of the site, Hover (1992j) found no evidence of contamination. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.27 PBF-02: PBF Control Area Septic Tanks (PBF-738 and -739), Seepage Pit (PBF-736)

The PBF-02 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The sanitary system comprises two 2,271-L (600-gal) septic tanks west of PBF-601 and a seepage pit located outside of the facility fence southwest of PBF-619. The system receives sanitary waste from the Control Building and Addition (PBF-601). The system, constructed in 1955, is still in use and presently receives only nonradiological, nonhazardous sanitary discharges. In an assessment of the site, Hover (1992k) found no evidence of contamination. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1991), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.28 PBF-03: PBF Control Area Septic Tank for PBF-632 and Seepage Pits (PBF-745 and -748)

The PBF-03 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The sanitary system comprises a septic tank with an estimated 3,785-L (1,000-gal) capacity and four seepage pits north of the PBF Support Building (PBF-632). The system, constructed in 1980, receives sanitary waste from the Support Building, is still in use, and presently receives only nonradiological, nonhazardous sanitary discharges. In an assessment of the site, Hover (1992*l*) found no evidence of contamination. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.29 PBF-04: PBF Control Area Oil Tank at PBF-608 (Substation) Outside PBF Fence

The PBF-04 site is the historical site of a 3,785-L (1,000-gal) underground storage tank used to store heating fuel for the PBF Substation Control House (PBF-608) from 1962 to 1976. The site is

immediately adjacent to the building and about 305 m (1,000 ft) south of the PBF Control Area. The tank was originally installed directly over the grounding grid for the 138-kv substation that services all of ARA, the five facilities within PBF, and the Security Training Facility. Excavated in 1990, the tank was found in very poor condition with observable rust and pinholes. Soils in the excavation were discolored. Because of safety issues related to the proximity of the substation and grounding grid, only 9 m^3 (12 yd^3) of contaminated soils were removed. The remaining soils were sampled for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylene, and the excavation was backfilled with clean soil. Benzene was identified in four of five samples at concentrations ranging from 0.1 to 0.4 mg/kg compared to a site-specific risk-based soil concentration of 0.088 mg/kg back calculated with GWSCREEN in the Track 1 evaluation of the site (EG&G June 1994). The only pathway of concern was ingestion of groundwater. Risk-based concentrations for all other pathways were at least two orders of magnitude greater than detected concentrations.

Sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997) for PBF-04. However, because this site has safety concerns related to the electrical grounding grid that underlies the site, the Work Plan identified that the sampling results from PBF-31 and PBF-32 would be correlated to PBF-04. Because the sampling results from PBF-31 and PBF-32 were below EPA Region 3 risk-based concentrations, PBF-04 was not retained for quantitative risk analysis in the WAG 5 comprehensive RI/BRA.

3.1.30 PBF-05: PBF Reactor Area Warm Waste Injection Well (PBF-301)

The PBF-05 site is a 33.5-m (110-ft) deep vadose zone injection well constructed in 1969 for the disposal of low-level radioactive waste and raw coolant water. No hazardous waste was discharged to the well. Though the well was drilled in 1969, it did not receive waste until 1973 when low-level radioactive waste and raw coolant water were routed to the well. Discharges were limited in activity to 18,800 counts per minute (cpm) above background. An approximate total of 0.48 Ci was released to the well. Radionuclides with contributions greater than 0.01 Ci and half-lives greater than 10 years are Cs-137 at 0.30 Ci and tritium at 0.02 Ci. From 1981 to 1984, raw coolant water was the only effluent. In 1984, discharge pipes to the well were sealed with concrete. The well was capped and also sealed with concrete. Though the Track 2 evaluation of the site (Hillman-Mason et al. 1994) found no unacceptable risks, the uncertainty in the results was sufficient to justify further evaluation of the groundwater ingestion pathway. The reevaluation incorporated a simulated revised source term and site-specific input parameters to the GWSCREEN fate and transport model. Results indicate a risk of 1E-06 from Sr-90 (see Rohe, Sondrup, and Whitaker 1996 in Appendix J). No other risks were identified. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The PBF-05 site was retained for quantitative risk analysis in the RI/BRA to evaluate the groundwater risks from Sr-90.

3.1.31 PBF-06: PBF Reactor Area Blowdown Pit for Reactor Boiler by PBF-621

The PBF-06 site is a ditch located west of the PBF Reactor Building. Since 1970, a pipe running from the oil-fired boiler has emptied approximately 114 L (30 gal) per day of blowdown water into the pit. Though the reactor became a fuel storage area in 1997, the boiler is still used to support ongoing activities at the facility, which require continued release of the boiler blowdown water. The blowdown water contains chemicals that are used to inhibit corrosion in the boiler. However, the corrosion inhibitors contain no chromate, are nontoxic, and are used in very small quantities. In a radiological survey conducted in 1991, no radiological contamination above background levels was found at this site (EG&G April 1993b). No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.32 PBF-07: PBF Reactor Area Oil Drum Storage (PER-T13)

The PBF-07 site is the location of an oil-drum storage area at the PBF Reactor Area. The site consists of a wholly enclosed 1.2 × 2.4-m (4 × 8-ft) concrete pad, which is used to temporarily store two or three 208-L (55-gal) drums of used oil and lubricant until pickup for recycling. The site initially only had a steel roof covering the oil drums, but in 1990, the pad was enclosed with metal corrugated siding and a drip pan was installed. No oil spills have been recorded, and the site shows no physical evidence of spillage. No hazardous substances have been stored on the pad (EG&G April 1993c), and a radiological survey conducted in 1991 detected no radiological activity above background. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was not retained for quantitative risk analysis in the RI/BRA.

3.1.33 PBF-08: PBF Reactor Area Corrosive Waste Disposal Sump Brine Tank (PBF-731)

The PBF-08 site is an unlined concrete sump structure with dimensions of 3.4 × 3.4 × 6.4 m (11 × 11 × 21 ft). Effluent routed to the sump from 1972 to 1984 included chromium-contaminated water from the PBF Reactor secondary coolant loop and discharges containing resins, sulfuric acid, and sulfur dioxide from the demineralizer system. The sump is still used by the PBF Reactor facility. Subsequent to 1984, discharges to the sump did not contain chromium (Ludi, Burns, and Hardy 1990). Sampling conducted before the FFA/CO (DOE-ID 1991) identified chromium and Cs-137 concentrations in the sump sediments that, if released, would be greater than risk-based levels. Therefore, an interim action was implemented. The interim action included removal of the sump contents, transportation and storage of the contents at the Mixed Waste Storage Facility (MWSF), and decontamination of the sump. The piping from the sump to the evaporation pond (PBF-733) was removed, and effluent from the sump was rerouted to a new disposal tank (Parsons 1995). Lack of activity on smear samples, collected from the interior of the sump at locations determined by radiological survey results, indicated the presence of fixed contamination. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). Because the assessment of the site indicated that the interim action had been successful, the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.34 PBF-09: PBF Reactor Area Septic Tank and Drain Field (PBF-728)

The PBF-09 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The sanitary system comprises a 3,785-L (1,000-gal) septic tank and a drain field that permits septic tank effluent to percolate through the soil. The system receives sanitary waste from the PBF Reactor building (PBF-620) and is located just northwest of the building. The system was constructed in 1970, is still in use, and presently receives only nonradiological, nonhazardous sanitary discharges. In an assessment of the site, Hover (1992m) found no evidence of contamination. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.35 PBF-10: PBF Reactor Area Evaporation Pond (PBF-733)

The PBF-10 site was a Hypalon-lined surface impoundment with an approximate area of 1,820 m^2 (19,600 ft^2). Effluent routed to the pond from 1972 to 1984 included chromium-contaminated water from the PBF Reactor secondary coolant loop, and discharges containing resins, sulfuric acid, and sulfur dioxide from the demineralizer system. Sulfur dioxide was added to the system to convert chromium(VI) to chromium(III). Subsequent to 1984, discharges to the pond did not contain chromium. In sampling (Ludi, Burns, and Hardy 1990) conducted before the FFA/CO (DOE-ID 1991) concentrations of total

chromium and Cs-137 were identified in the pond sediments at greater than risk-based levels. Therefore, an interim action was implemented. The 1994 interim action (Parsons 1995) included excavation of sediments from the pond in areas with chromium concentrations greater than 800 mg/kg or Cs-137 concentrations greater than 30 pCi/g. Post-removal verification sampling from sediments above and below the liner verified the adequacy of the interim action (Parsons 1995). The pond was divided into 49 grids, each with an area of 37 m^2 (400 ft^2). Sediments were removed down to the liner in 21 of the 49 grids, containerized, and transported to the RWMC. Post-removal samples collected above the liner yielded Cs-137 concentrations ranging from 11.17 to 17.5 pCi/g and chromium concentrations ranging from 213.0 to 309.0 mg/kg. One of four locations sampled below the liner had a Cs-137 concentration of 0.04 pCi/g. Cesium was not detected in the other three samples. Chromium was detected below the liner in concentrations ranging from 14.4 to 23.0 mg/kg. In 1995, the pond liner was removed and disposed of in the Central Facilities Area Bulky Waste Landfill (see Hiaring 1995 in Appendix J). The berm was pushed into the pond, and the area was graded and seeded with native grasses. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The PBF-10 site was retained for quantitative risk assessment in the RI/BRA to evaluate the risk potential from Cs-137 contamination remaining in the evaporation pond soils after the completion of the interim action.

3.1.36 PBF-11: PBF SPERT-I Seepage Pit (PBF-750)

The PBF-11 site is a circular seepage pit with a 9-m (30-ft) diameter and a depth of 5 m (15 ft). The pit was the terminus of demineralizer regeneration effluent associated with the operation of the Special Power Excursion Reactor Test (SPERT) -I reactor. The reactor was operative from 1955 to 1964. The wastewater contained sulfuric acid and sodium hydroxide, an acid and a base that tend to neutralize. Vegetation observed growing in the bottom of the pit supported the conclusion that the soils in the bottom of the pit were not corrosive. Radiological surveys did not yield detection of beta-gamma or alpha contamination. In the Track 2 evaluation for the site (Hillman-Mason et al. 1994), the seepage pit was concluded not to be a source of unacceptable risk. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). Because PBF-11 was assessed as free from significant hazardous or radiological contamination, the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.37 PBF-12: PBF SPERT-I Leach Pond

The PBF-12 site is the historical location of a 4.6 × 13.7-m (15 × 45-ft) diked, unlined surface impoundment originally called the SPERT-I Warm Waste Seepage Pit. The site received radiologically contaminated and nonradioactive overflow from the SPERT-I reactor pit on a sporadic basis from 1955 to 1964. Waste from the reactor sump also was routed to the pond. In 1984, D&D was performed at the site (EG&G March 1993a). Remediation included removing the drain line and the top 0.8 m (2.5 ft) of contaminated soil. Soil samples were collected, and preliminary gamma-spectroscopy field results were used to justify the decision to proceed with backfilling with clean soil. The area was mounded slightly with a 2.4-m (8-ft) cover of clean soil and seeded with grass. Subsequent laboratory analysis of the soil samples indicated that soil contaminated with low levels of residual radioactivity remained at the site. Cesium-137 concentrations ranged from 0.57 to 31.4 pCi/g in eight post-D&D samples (Suckel 1984). Two concentrations of U-235 (0.27 and 1.6 pCi/g), and two concentrations of Sr-90 (1.4 and 2.25 pCi/g) were detected. Cobalt-60 was detected in six of eight locations in concentrations ranging from 0.28 to 2.0 pCi/g. Plutonium-238, U-234 and U-238 also were detected at concentrations slightly above background values developed by Rood, Harris, and White (1996). After completion of the D&D, the new surface of the site was surveyed and the maximum surface reading was 76 cpm. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The PBF-12 site was retained for quantitative risk analysis in the RI/BRA to assess the risk potential from Cs-137, Co-60, Pu-238, Sr-90, U-234, U-235, and U-238.

3.1.38 PBF-13: PBF Reactor Area Rubble Pit

The PBF-13 site is a rubble pit located north of the PBF Reactor Area cooling tower. The rubble pit was first used to dispose of soil and basalt pieces excavated during facility construction in the late 1960s and later was used, until the mid-1970s, as a dump for a variety of construction materials. Fence posts mark the location of the dumping area, which is 23 × 14 × 3 m (75 × 45 × 10 ft). The dump received lumber, rusting empty barrels, cans, cable, concrete, and piping with asbestos insulation. All visible materials containing asbestos were removed from the pit in 1993. Any small quantity that remains was covered when the pit was backfilled with 0.9 to 3.7 m (3 to 12 ft) of clean soil and basalt rubble. Soil samples indicated the presence of cadmium, chromium, lead, nickel, and zinc in small amounts consistent with background levels. Volatiles detected at very low concentrations were acetone and toluene (EG&G 1993a). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was not retained for quantitative risk analysis in the RI/BRA.

3.1.39 PBF-14: PBF SPERT-II Inactive Fuel Oil Tank (Front of PBF-612)

The PBF-14 site is the location of an abandoned 1,893-L (500-gal) underground storage tank once used to supply gasoline to an emergency generator. The tank was in service from approximately 1960 to 1964. The tank was filled with sand and abandoned in place, and the fuel line was disconnected. Two posts prevent parking on the tank site. The top of the tank is about 0.6 m (2 ft) below the surface. During the Track 1 investigation of the site (EG&G October 1993), soils were excavated down to the top of the tank to a depth of 0.6 to 0.8 m (2 to 2.5 ft). No stained soils were visible, VOCs were not detected using field instruments, and no holes were observed in either the tank or associated piping (EG&G October 1993). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was not retained for quantitative risk analysis in the RI/BRA.

3.1.40 PBF-15: PBF Reactor Area Corrosive Waste Injection Well (PBF-302)

The PBF-15 site is a vadose zone injection well constructed in 1969 and 35 m (116 ft) deep. From 1972 to 1978, the well received discharge from regeneration of the PBF Reactor demineralizers and from the PBF Reactor secondary coolant system. Discharges to the well were rerouted to the PBF Evaporation Pond in 1978. The historical disposals included an average of 1.1E+06 L/year (2.9E+05 gal/year) of wastewater containing sulfuric acid, sodium hydroxide, chromium, hydrazine, and zinc. A Track 2 evaluation of the site found no unacceptable risks (Hillman-Mason et al. 1994); however, uncertainty in the results was sufficient to justify further evaluation of the groundwater ingestion pathway. The reevaluation incorporated a simulated revised source term and site-specific input parameters to the GWSCREEN fate and transport model (see Rohe, Sondrup, and Whitaker 1996 in Appendix J). The results indicated a risk of 1E-06 from hydrazine, but predicted that the peak concentration occurs at approximately 0.5 years after a release. Historical records indicate that the releases occurred from 1971 to 1978. This contaminant of potential concern (COPC) has a very low retardation factor and the simulated hydrazine groundwater concentration falls below the 1E-06 risk-based concentration within 2 years of the release (see Rohe, Sondrup, and Whitaker 1996 in Appendix J). No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). Based on the GWSCREEN modeling, which identified no unacceptable risks, PBF-15 was eliminated from the quantitative risk analysis.

3.1.41 PBF-16: PBF SPERT-II Leach Pond

The PBF-16 site is a fenced, unlined surface impoundment, with approximate dimensions of 70 × 51 m (230 × 167 ft), located south of the SPERT-II Reactor Building. From 1959 to 1964, the leach

pond was used for disposal of demineralizer effluent, water softener waste, emergency shower drain water, and discharges from the floor drains from the reactor building. Currently, the only discharge to the pond is clean water from the PBF maintenance shop air compressor (Hillman-Mason et al. 1994). A characterization of the leach pond was conducted in 1982 and 1983. The 1982 characterization (EG&G 1982) consisted of collecting 18 soil, two water, and several vegetation samples and analyzing for radionuclides. The radioactivity levels were within background values. In 1983, the pond was characterized for hazardous constituents. Only mercury and lead were detected above INEEL background concentrations (Hillman-Mason et al. 1994). Mercury was detected at 0.71 mg/kg, which is below the EPA Region 3 risk-based concentration. Lead was detected at 32 mg/kg. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The PBF-16 site was retained for quantitative analysis in the RI/BRA to assess the risk potential from lead.

3.1.42 PBF-17: PBF SPERT-II Septic Tank and Seepage Pit (PBF-725)

The PBF-17 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The sanitary system includes a 3,785-L (1,000-gal) septic tank and a seepage pit located north of the SPERT-II (PBF-622). The building was later converted to the Waste Engineering Development Facility (WEDF). The system receives sanitary waste from the WEDF, was constructed in 1960, and is still in use. In an assessment of the site, Hover (1992n) found no evidence of contamination, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was not retained for quantitative analysis in the RI/BRA.

3.1.43 PBF-19: PBF SPERT-III Inactive Fuel Oil Tank (West Side of the WERF)

The PBF-19 site is likely the former location of an 11,355-L (3,000-gal) underground fuel oil storage tank associated with the furnace in the reactor building at SPERT-III (EG&G May 1993). As discussed in the Track 1 evaluation (EG&G May 1993), documentation from 1986 indicates that the tank and any contaminated soil associated with the tank were scheduled for removal, but post-removal records were not found. An attempt was made using geophysics to confirm the removal of the tank, but because of interference from nearby structures and the pavement, the survey was inconclusive. Interviews of personnel verified removal of the tank and any associated contaminated soils (EG&G May 1993). The area has since been paved and is now used for outside storage. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative risk analysis in the RI/BRA.

3.1.44 PBF-20: PBF SPERT-III Small Leach Pond

The PBF-20 site was a small leach pond located just north of WERF. The pond was a 10 × 10-m (30 × 30-ft) gravel pit that was used as a leach pond for disposal of sulfuric acid and sodium hydroxide solutions coming from the SPERT-III demineralizers. The pond area was sampled and backfilled by the D&D program in 1982. No unacceptable risks were found in the Track 2 investigation of the site (Hillman-Mason et al. 1994). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The PBF-20 site was not retained for quantitative risk analysis in the RI/BRA.

3.1.45 PBF-21: PBF SPERT-III Large Leach Pond

The PBF-21 site is the historical location of a leach pond that received waste from the sump pump in the SPERT-III Reactor Building from 1958 to 1968. Primary coolant water was drained to the pond.

The pond was characterized in 1982 and subsequently backfilled by the D&D program. The D&D data were reviewed during the Track 1 qualitative risk assessment (EG&G 1994) and were found insufficient to support a No Further Action recommendation because hazardous constituents had not been analyzed. Additional samples were collected in 1993 to determine the presence or absence of hazardous substances. No concentrations were detected above risk-based soil concentrations, but the lowest elevation in the pond was not sampled. However, evidence indicates that low-level radioactive contaminated soils are located beneath the surface at depths of 7 to 8 ft. The Track 1 evaluation of the site (EG&G 1994) identified unacceptable risk via the external exposure pathway in both the occupational and 100-year future residential intrusion scenarios. Cesium-137 concentrations were detected in a range from 0.2 to 18.0 pCi/g. Cobalt-60 was detected in concentrations from 0.8 to 6.5 pCi/g. All other detected radioactivity was below the background values developed by Rood, Harris, and White (1996). No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was retained for quantitative risk analysis to evaluate the risk potential from chloride, orthophosphate, sulfate, Co-60, Cs-137, U-234, U-235, and U-238.

3.1.46 PBF-22: PBF SPERT-IV Leach Pond (PBF-758)

The PBF-22 site was an unlined surface impoundment that received effluent from the SPERT-IV reactor from 1961 to 1970. Effluent consisted of radioactively contaminated wastewater, emergency shower water, and demineralizer discharges. Occasional discharges from the waste holdup tank were routed to the pond from 1979 to 1981. In the early 1980s, the pond received contaminated primary coolant effluents from the SPERT-IV Reactor. In 1985, the area was surveyed, and approximately six 0.6 × 1.2 × 2.4-m (2 × 4 × 8-ft) boxes of soil were removed and transported to the RWMC. Sample results from 1988 and 1994 were evaluated and Aroclor 1254, chromium, and mercury were detected at 0.780, 147, and 0.11 mg/kg, respectively. A Track 2 evaluation was performed for the site, and no unacceptable risks were identified (Hillman-Mason et al. 1994). Potential risks from groundwater ingestion were reevaluated in 1996 (see Rohe, Sondrup, and Whitaker 1996 in Appendix J). Because of insufficient discharge history, the source term was assumed to comprise the entire area of the pond to a depth of 3 m at the highest concentrations detected in 1988. The reevaluation indicates a risk of 1E-06 because of Aroclor-1254, but unsaturated travel time is more than 1,000 years with peak at 1.56E+4 years (see Rohe, Sondrup, and Whitaker 1996 in Appendix J). No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was retained for quantitative risk analysis to evaluate the risk potential from arsenic, lead, manganese, Am-241, Cs-137, Pu-238, Pu-239, Th-228, Th-230, Th-232, U-234, and U-238.

3.1.47 PBF-24: PBF SPERT-IV Blowdown Pit (Adjacent to PBF-716)

The PBF-24 site is a boiler blowdown pit that was used for drainage of the SPERT-IV Reactor building boiler water from 1960 to 1971. The 0.6 × 0.6 × 1.8-m (2 × 2 × 6-ft) pit, located 9 m (30 ft) north of the reactor building, is a subsurface reinforced concrete structure with an open gravel base for drainage. A pipe running from the oil-fired boiler emptied approximately 114 L (30 gal) per day of blowdown water into the pit. The blowdown water contained some chemicals that were used to inhibit corrosion. However, the corrosion inhibitors that were used contained no hazardous chemicals, were nontoxic, and used in very small quantities. Radiological surveys show no radiological contamination above background levels at this site (EG&G March 1993b). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents, and no sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was not retained for quantitative analysis in the RI/BRA.

3.1.48 PBF-25: PBF SPERT-IV Septic Tank and Leach Pit (PBF-727, -757)

The PBF-25 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The sanitary system includes a 3,785-L (1,000-gal) septic tank and leach pit located southeast of the MWSF. The system receives sanitary waste from the MWSF, was constructed in 1962, and is still in use. In an assessment of the site, Hover (1992o) found no evidence of contamination. In 1994, the site was proposed for reevaluation on the basis of anecdotal information, which indicated that the system may have received waste from a temporary photographic laboratory. An investigation found that the concern was unwarranted (see Hiaring 1998b in Appendix J). Sample results from 1993 indicated that no contaminant levels of metals were above regulatory levels. Furthermore, a review of construction drawings indicated that the closet that once held the temporary darkroom did not drain to the septic system, but rather to the sump in the lower levels of the reactor pit that collected contaminated waste (see Hiaring 1998b in Appendix J). No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative analysis in the RI/BRA.

3.1.49 PBF-26: PBF SPERT-IV Lake

The PBF-26 site is a surface impoundment constructed in 1960 by erecting a dike 91 × 1.8 m (300 × 6 ft) high, composed of soil and rock, to close off an irregularly shaped natural depression. The dike formed a containment area with an approximate volume of 23 million L (6 million gal). The center of the area is approximately 244 m (800 ft) south of the MWSF. From 1961 to 1970, the lake received uncontaminated cooling water from the secondary loop of the SPERT-IV Reactor and was inactive until 1985. From 1985 to 1992, the only discharges to the lake were uncontaminated effluent from Three Mile Island studies and discharges generated by periodic testing of emergency eye wash and shower stations. With the removal of the pipeline to the lake in 1992, all discharges to the lake ended. Historical sampling showed a single high detection of 13 mg/kg of Aroclor-1254, and potential risks from Cs-137, uranium, and chromium were identified (EG&G 1993b). But the source of the contamination is unknown. Low concentrations of PCBs also were detected in the pipeline between the lake and the MWSF. A time-critical removal action was recommended for the site. In 1995, before the removal action, field immunoassay kits for PCBs were used to determine the vertical and horizontal extent of contamination. Using the immunoassay kits, only one location was detected with a concentration greater than the 10-mg/kg field screening level agreed upon by DOE, EPA, and IDHW (see Hiaring 1998a in Appendix J). The duplicate confirmation sample sent to an off-Site lab indicated a PCB concentration of 4.4 mg/kg. Cesium-137 was detected in five samples with concentrations ranging from 0.70 to 4.7 pCi/g (see Hiaring 1998a in Appendix J). Because the analytical results for PCB were below the 10 mg/kg field screening level, the planned removal action was not performed. It is possible that the PCB contamination was removed during sampling. Though the results of the 1995 sampling activity failed to identify PCB contamination, this site was included for evaluation in the BRA. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997). The site was retained for quantitative risk analysis in the RI/BRA to evaluate the risk potential from arsenic, lead, Aroclor-1254, and Cs-137.

3.1.50 PBF-27: PBF SPERT-III Septic Tank (PBF-726) and Seepage Pit

The PBF-27 site is one of 16 sites previously investigated under the COCA (DOE-ID 1986) and transferred under the FFA/CO (DOE-ID 1991) as a No Action site without assignment to an OU. The sanitary system includes a 2,366-L (625-gal) septic tank and a seepage pit that receives sanitary waste from the Waste Experimental Reduction Facility (WERF) building (PBF-609). The system was constructed in 1959 and is still in use. In an assessment of the site, Hover (1992p) found no evidence of contamination. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative analysis in the RI/BRA.

3.1.51 PBF-28: PBF Reactor Area Cooling Tower Area and Drainage Ditch

The PBF-28 site consists of an overspray area of surface soils and drainage ditch that is south and west of the PBF Reactor Area cooling tower. The reactor cooling tower began service in 1976 and received uncontaminated reactor secondary-cooling water until 1985. The drainage ditch was constructed in the early 1970s and is approximately 183 m (600 ft) in length. This drainage ditch was used for surface runoff drainage from the PBF Reactor Area and also received water from the boiler blowdown tank and secondary cooling water from the cooling towers. Soil samples were collected along the entire length of the drainage ditch and the overspray area and were analyzed for chromium, which is the primary COPC. The results indicated that a 30 × 30-m (100 × 100-ft) area was contaminated by aerosol overspray from the cooling tower. However, the concentrations of chromium found at this site are substantially below risk-based contaminant levels, and surveys indicated no radiological activity above background levels for the cooling tower area or the drainage ditch (EG&G March 1993c). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative analysis in the RI/BRA.

3.1.52 PBF-29: PBF Reactor Area Abandoned Fuel Oil Tank

The PBF-29 site is the location of an abandoned fuel oil tank located southeast of the PBF Reactor building at the northwest corner of Parking Area No. 9. This tank serviced a construction building that was demolished in 1971, and the tank was abandoned in place below the building pad. The tank was sampled in 1993 by PBF operations personnel and was found to contain only water (DOE-ID 1997). In 1996, the tank was removed. During the removal, no stained soils were visible, VOCs were not detected, and no holes were observed in either the tank or associated piping. The area was backfilled and covered with asphalt (DOE-ID 1997). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative analysis in the RI/BRA.

3.1.53 PBF-30: PBF Reactor Area Abandoned Septic System

The PBF-30 site is the location of an abandoned septic system southeast of the PBF Reactor building at the northwest corner of Parking Area No. 9. The system includes a 3,785-L (1,000-gal) septic tank and subsurface drain field that once serviced a construction building. The construction building was demolished in 1971. In an examination of the site, the area of the tank was found to be covered by a temporary storage shed. All plumbing to the tank was closed. The tank contents were sampled, and no radioactivity or hazardous substance was detected above regulatory levels (see Pollitt 1998 in Appendix J). The site was assessed as free of significant contamination from either radiological or hazardous waste constituents. No sampling data gaps were identified in the WAG 5 Work Plan (DOE-ID 1997), and the site was not retained for quantitative analysis in the RI/BRA.

3.1.54 PBF-31: SPERT-II Fuel Oil Tank (PBF-732)

The PBF-31 site was identified as a site subsequent to the publication of the FFA/CO (DOE-ID 1991) and was added to the list of WAG 5 sites. The site is the historical location of a 7,571-L (2,000-gal) underground storage tank used to supply heating fuel to the WEDF. The tank was installed in 1960 and removed and replaced in 1994. During excavation in 1994, it was discovered that the tank had leaked an unknown quantity of fuel oil that saturated the surrounding soils and penetrated the underlying basalt. All contaminated soils were removed from the site; however, the product released into the underlying basalt layer could not be recovered. The site was evaluated under the Track 1 process (see

Pollitt 1998 in Appendix J). The initial evaluation eliminated the risk potential for all pathways except for the ingestion of benzene-contaminated groundwater.

Several data needs were identified in the WAG 5 Work Plan (DOE-ID 1997). These data needs were to define the vertical extent of the soil and bedrock contamination and to evaluate the benzene degradation potential and capacity in the vadose zone. To meet these data needs, the WAG 5 FSP (DOE-ID 1997) specified collection of one sample from the interbed for metals and TPH analysis after completion of a borehole. Samples would be collected for benzene, toluene, ethylbenzene, and xylene (BTEX) analysis during the actual drilling operation. After completion of drilling, vapor ports would be installed at three locations: (1) the lower vapor port would be installed in the first significant fracture zone above the interbed, (2) the middle vapor port would be installed in a fracture zone approximately 30 m (100 ft) bls, and (3) the upper vapor port would be installed in a rubble zone at approximately 15 m (50 ft) bls. Soil gas samples for VOC analysis would be collected from each of the three vapor ports.

At PBF-31, the interbeds were thinner than anticipated and because sample volume was limited, only critical samples were collected (Wilson-Lopez 1997). The vapor ports were installed at 6.1 to 7.6 m (20 to 25 ft) bls, 20.4 to 21.9 m (67 to 72 ft) bls, and 35.1 to 36.6 m (115 to 120 ft) bls. These vapor ports were sampled approximately 1 month after they were installed and sent for laboratory analysis (Wilson-Lopez 1997). The sampling data gaps identified in the WAG 5 Work Plan (DOE-ID 1997) have been filled, and the analytical results are presented in Appendix E. Because the sampling results from PBF-31 were below EPA Region 3 risk-based concentrations, this site was not retained for quantitative risk analysis in the WAG 5 comprehensive RI/BRA.

3.1.55 PBF-32: PBF Control Area Fuel Oil Tank (PBF-742)

The PBF-32 site is one of seven sites identified subsequent to the publication of the FFA/CO (DOE-ID 1991). The site is the historical location of a 7,570-L (2,000-gal) underground storage tank used to supply heating fuel to the PBF Control Building (PBF-601). The tank was installed in 1954 and removed and replaced in 1994. During excavation in 1994, it was discovered that the tank had leaked an unknown quantity of fuel oil, saturated the surrounding soils, and penetrated the underlying basalt. All contaminated soils were removed from the site. However, the product released into the underlying basalt layer could not be recovered. The site was evaluated under the Track 1 process (see Pollitt 1998 in Appendix J). The initial evaluation eliminated the risk potential for all pathways except ingestion of benzene-contaminated groundwater.

Several data needs were identified in the WAG 5 Work Plan (DOE-ID 1997). These data needs were to define the vertical extent of the soil and bedrock contamination and to evaluate the benzene degradation potential and capacity in the vadose zone. To meet these data needs, the WAG 5 FSP (DOE-ID 1997) specified collection of one sample from the interbed for metals and TPH analysis after completion of a borehole. Opportunity samples would be collected for BTEX analysis during the actual drilling operation. After completion of drilling, vapor ports would be installed at three locations: (1) the lower vapor port would be installed in the first significant fracture zone above the interbed, (2) the middle vapor port would be installed in a fracture zone approximately 30 m (100 ft) bls, and (3) the upper vapor port would be installed in a rubble zone at approximately 15 m (50 ft) bls. Soil gas samples for VOC analysis would be collected from each of the three vapor ports.

At PBF-32, the interbeds were thinner than anticipated and because the sample volume was limited, only critical samples were collected (Wilson-Lopez 1997). The vapor ports were installed at 21 to 24 ft bls, 63 to 68 ft bls, and 118 to 123 ft bls (Wilson-Lopez 1997). These vapor ports were sampled approximately 1 month after they were installed and sent for laboratory analysis. The analytical results for the interbed and vapor sampling are presented in Appendix E. In addition, the sampling data

gaps identified in the WAG 5 Work Plan (DOE-ID 1997) have been filled. Because the sampling results from PBF-32 were below EPA Region 3 risk-based concentrations, this site was not retained for quantitative risk analysis in the WAG 5 comprehensive RI/BRA

3.2 Quality Assurance/Quality Control Sampling

The purpose of collecting and analyzing quality assurance and quality control (QA/QC) samples is to confirm the achievement of project objectives and data quality objectives (DQOs). The overall objectives associated with the WAG 5 comprehensive RI/FS sampling activities are discussed in the WAG 5 Work Plan (DOE-ID 1997). Specific DQOs are discussed in the WAG 5 FSP (DOE-ID 1997) for the comprehensive RI/FS. The planned data uses, sampling design, types of analyses, required detection limits, precision, accuracy, completeness, and comparability needs for each sampling and analysis event are identified in the following sections. The evaluation of DQOs and the extent to which objectives were achieved in the WAG 5 comprehensive investigation also are discussed. All data collected in this investigation were validated to method validation Level A in accordance with the LMITCO *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, and 10* (QAPjP) (Baumer, Flynn, and Watkins 1995) as prescribed by LMITCO methods for data validation (LMITCO 1995).

Sampling activities were identified for eight individual sites in the WAG 5 Work Plan and FSP (DOE-ID 1997): ARA-01, ARA-02, ARA-10, ARA-16, ARA-23, ARA-24, PBF-31, and PBF-32. In Section 3.1, the data needs for each site are described and the sampling activities and deviations from the FSP are summarized. The Work Plan also specified sampling from the aquifer beneath WAG 5. The DQOs associated with all sampling and analysis completed under the WAG 5 comprehensive RI/FS sampling plan are discussed below.

3.2.1 Precision and Accuracy

The spatial variations in the concentrations of contaminants at individual sites create sampling variability. Additional variability, called measurement error, occurs during sample collection, handling, processing, analysis, quality evaluation, and reporting. Concentrations of contaminants reported represent the true concentrations in the media sampled plus the measurement error, which can be minimized but not eliminated. Though it may not be significant in many cases, it is important to assess the contribution of measurement error to the total error in individual investigations. The analytical results of quality control (QC) samples are used to estimate accuracy and precision, the quantitative descriptions of measurement error and bias.

3.2.1.1 Overall Precision. Precision is a measure of the reproducibility of measurements under a given set of conditions. In the field, precision is affected by sample collection procedures and the natural heterogeneity in the soil. Overall precision (field and laboratory) can be evaluated by the use of duplicate samples collected in the field. Greater precision typically is required for chemicals with very low action levels that are close to background concentrations. Laboratory precision for soil and waste samples is defined as having a relative percent difference (RDP) less than or equal to 30%, and for water samples, the RPD is less than or equal to 20%. Field precision is the difference between overall precision and laboratory precision.

For ARA-01, two field duplicates were collected and analyzed for alpha-emitting isotopes (Am-241, Pu-238, Pu-239/240, U-234, U-235, and U-238) and Sr-90. Neither Sr-90 nor Pu-238 was detected in any of the samples or field duplicates. For Am-241, either the sample or the field duplicate contained statistically positive activity and the other did not. The RPD in this case was calculated using the statistically positive result and one-half the minimum detectable activity for the nonstatistically positive result. In Appendix E, the RPDs between the samples and field duplicates are presented for

isotopes for which concentrations at the minimum detection limits are present. For analytes with concentrations bordering on the minimum detectable activity (i.e., Pu-239/240, U-235, and Am-241), the RPDs are high, which indicates poor overall precision. The RPDs for U-234 and U-238 show fairly good agreement between the field duplicates.

While laboratory precision determined by analytical method data validation techniques is acceptable, the contribution to overall precision is enormous. Laboratory precision for radionuclides is calculated as a mean difference rather than a relative percent difference. The mean difference calculation takes into account the uncertainty associated with each individual result, whereas the RPD does not. For example, the Pu-239/240 mean difference for one duplicate pair is 0.513, which is acceptable. However, the actual RPD for this sample pair is 42.7%. When comparing the Pu-239/240 RPD for the field duplicate (33.8%) to the laboratory duplicate of the same sample (42.9%), the overall precision, or rather, imprecision, is as much attributable to the laboratory as the field. The anomaly is caused by sample concentrations that approach the detection limit. The results do not indicate that the analytical results are not usable for their intended purpose, but rather that any use of the data should be bounded by the uncertainty associated with measurement at or near the method detection capability. The high RPDs for Am-241 for cases in which either the sample or its duplicate is a statistically positive value, whereas the other is a statistical nondetection, also supports the conclusion that data measurement uncertainty should be considered to determine data usability.

For ARA-02, one field duplicate was collected and analyzed for anions, cyanide, dioxins and furans, metals, organochlorinated pesticides, organophosphorous pesticides, herbicides, PCBs, radionuclides, semivolatile organic compounds (SVOCs), toxicity characteristic leaching procedure (TCLP) metals, TCLP VOCs, VOCs, and polynuclear aromatic hydrocarbons (PAHs). The concentrations and RPDs for the detected analytes are summarized in Appendix E. As with ARA-01, one-half of the detection limit was used to calculate the RPD for analyte concentrations below the detection limit.

For ARA-02, only one duplicate was collected, making a quantitative evaluation of precision impossible. However, a qualitative evaluation based on the RPDs can be performed. Relatively poor overall precision is demonstrated for fluoride, chloride, arsenic, Cs-137, and TCLP cadmium. The chloride, arsenic, and TCLP cadmium concentrations border method detection limits, adding to the difficulty associated with quantifying the analytes. The high RPDs associated with Cs-137 and fluoride may be attributed to heterogeneity in the soils at the site or errors introduced in the sampling and analytical process. As with ARA-01, as long as the risk assessment takes into account the uncertainty bounds defined by the overall precision, the results will serve their intended purpose. The high RPDs for ARA-02 data are attributed to the comparison of an actual analytical result to a detection limit. Either the sample or the field duplicate was a detected result; whereas, the other was not, providing a bias that may or may not be attributable to the overall precision. The poor precision represented by the fluoride and cesium-137 duplicate results is a source of concern. While fluoride is a difficult analysis, the high RPD cannot be attributed to poor laboratory precision. The Cs-137 (gamma) analysis is straightforward with no preparatory steps (unlike for fluoride analysis), yet the RPD for the Cs-137 laboratory duplicate is 5.8% as compared to an RPD of 118.7% for the field duplicate. It is apparent from these results that there is a source of uncertainty attributable to the field activities. So long as the end use of the data is bounded by the uncertainty represented by the analytical measurements, the analytical data are acceptable for the end use.

For ARA-16 soils, two field duplicates were collected and analyzed for SVOCs, PCBs, radionuclides, metals, and VOCs. The analyte concentrations and RPDs for the detected analytes are summarized in Appendix E.

As with ARA-01 and ARA-02, higher RPDs are associated with those analytes with concentrations near the method detection limits. The RPDs for a few analytes (i.e., Co-60, gross alpha, and gross beta) may be attributed to heterogeneity in the soils or errors introduced in the sampling and analytical process.

For the ARA-16 tank contents, duplicate samples of the tank sludge and liquid were collected and analyzed for SVOCs, PCBs, metals, radionuclides (except for tritium), VOCs, pH, reactive cyanide, reactive sulfide, total organic halides, and total organic carbon. A duplicate sample of the liquid was collected and analyzed for anions, cyanide, tritium, total sulfate, total suspended solids, density, hardness, oil, and grease. In addition, a duplicate sample of the sludge was collected and analyzed for the flash point, moisture content, and bulk density. The concentrations and RPDs for the detected analytes are summarized in Appendix E.

The high RPDs for VOC and SVOC analyses are related to the reporting by a laboratory of a result for either the sample or its duplicate and only the method quantitation limit for the other. The laboratory dilution raised the quantitation limit to a level that does not allow for an accurate representation of the duplicate precision when calculating an RPD based on an analytical result as compared to the quantitation limit. The inorganic and radionuclide results offer a better representation of the precision of the sample versus the field duplicate. As can be seen from the inorganic and radionuclide results, precision is marginal for the samples, especially when comparing the sludge results. This does not indicate that the data are unacceptable for the end use. The data provide an excellent representation of the tank contents, as well as an estimate of the uncertainty of the distribution of contaminants within the tank. Coupled with process knowledge and historical data, potential disposal options for the tank contents can be formulated.

For the ARA-16 soils, high imprecision can be calculated for various radionuclides, cadmium, and two VOCs. Many of these high RPDs can be directly attributed to either the sample or its field duplicate having a detectable concentration, while the other is reported only as a detection level. As previously stated for ARA-01 and ARA-02, the inconsistency is likely attributable to the use of one-half the dectection limit to calculate the RPD, and is not a reflection of overall poor precision. Therefore, for ARA-16 soils, the RPDs are probably valid only for Co-60 and the gross-beta results. To first address the Co-60 result, while an RPD of 50.1% is calculated for one field duplicate pair, the Cs-137 RPD for this same sample is 8.3%. Because Co-60 and Cs-137 are both gamma emitters and analyzed at the same time and the precision for the Cs-137 result is very good, the imprecision represented by the Co-60 duplicate results is questionable and may be attributable to the low concentration of Co-60 in the sample relative to the concentration of Cs-137. Gross-beta analysis is more of a screening tool, and the high RPD is most likely attributable to the analytical method rather than the sample collection, a conclusion supported by the precision provided by the Cs-137 measurement. Therefore, the analytical data are acceptable for the end use.

For ARA-23, one field duplicate was collected and analyzed for alpha- and gamma-emitting isotopes (U-234, U-235, U-238, Pu-238, Pu-239/240, Th-228, Th-230, Th-232, and Am-241) and Sr-90. None of three isotopes, U-235, Pu-238, or Pu-239/240, was detected in the sample or the duplicate at the detection limits employed. The RPDs between the sample and field duplicate for all other isotopes are summarized in Appendix E.

The RPD for Ra-226 demonstrates questionable precision between the sample and its field duplicate. The Ra-226 results were flagged with a "J" during data validation to indicate questionable results attributed to the analytical method. The Ra-226 results are questionable because of possible U-235 interference. Both U-235 and Ra-226 emit gamma rays in basically the same energy region of the spectrum, and the energies are so similar that they cannot be differentiated. However, the branching ratio for U-235 is higher than that for Ra-226. It is important to note that because uranium occurs naturally in soil, U-235 will always be present and contribute to the Ra-226 result. Therefore, the Ra-226 results and

RPDs should be viewed keeping this possible contribution in mind. A comparison of the sample to the field duplicate showed good precision for all other analytical sampling results for ARA-23. Because the RPDs for all other analytes were acceptable, the analytical data are acceptable for the end use.

For the WAG 5 groundwater monitoring effort, one field duplicate was collected and analyzed for hydrazine, anion, CLP metal, PCB, gross-alpha, gross-beta, gamma-spectrometric, tritium, I-129, and VOC analyses. For hydrazine, gross-alpha, gross-beta, gamma-spectrometric, and I-129 analyses, neither the sample nor its field duplicate contained the target analyte at levels above the detection limit employed; therefore, the RPD was not calculated for these analyses. The RPDs for the detected analytes are summarized in Appendix E.

A comparison of the samples to the field duplicates indicates overall excellent precision for WAG 5 groundwater.

3.2.1.2 Overall Accuracy. Accuracy is a measure of bias in a measurement system. Accuracy is affected by methods used for sample preservation, sample handling, field contamination, and the sample matrix used in the field. The effects of the first three can be assessed by the evaluation of the results of field blanks and equipment rinsates. For ARA-01 neither field blanks nor equipment rinsates were collected. The ARA-01 chemical evaporation pond is located within the ARA-23 windblown contamination site. Both sites were sampled at the same time, and samples were sent to the same laboratory for the same analyses. Therefore, field blanks and equipment rinsates were collected only for the ARA-23 sampling.

The presence of a contaminant in the field blank or rinsate reveals that cross-contamination has occurred. Assessing the magnitude of the contamination on the actual sample matrix is difficult because the blanks are an aqueous medium and the samples may be of another type of medium (e.g., soil).

For ARA-02 soils, both a field blank and an equipment rinsate were collected as required by the LMITCO QAPjP (Baumer, Flynn, and Watkins 1995). The field blank contained minor concentrations of calcium, sodium, and Am-241. The equipment rinsate had detectable levels of aluminum, barium, calcium, chloride, copper, fluoride, iron, magnesium, sodium, and zinc. The contaminant concentrations contained in either the field blanks or the equipment rinsate may indicate contamination for some samples.

For ARA-10 soils, both a field blank and an equipment rinsate were collected as required by the LMITCO QAPjP. Neither the field blank nor the equipment rinsate contained detectable concentrations of any of the analytes.

For the ARA-16 soil sampling effort, a field blank and equipment rinsate were collected as required by the QAPjP. The field blank contained detectable concentrations of aluminum, calcium, copper, iron, magnesium, manganese, sodium, and zinc. The equipment rinsate did not contain any detectable concentrations for the required analyses.

For the ARA-16 tank contents, a field blank and a trip blank were collected as required by the QAPjP. For the field blank, Co-60, U-234, and tritium were detected. For the trip blank, only toluene was detected. The contribution to the sample concentration for any of these analytes would be negligible.

For the ARA-23 sampling effort, field blanks and equipment rinsate were collected as required by the QAPjP. For both the field blank and equipment rinsate, U-234 and U-238 were detected and may indicate sample contamination. Uranium-235 also was detected in the equipment rinsate and may

indicate contamination for those samples in which U-235 has been detected. However, U-235 was below the method detection limit for several samples.

For both the PBF-31 and PBF-32 sampling efforts, a field blank and an equipment rinsate were collected as required by the QAPjP. Only the rinsate collected during the PBF-31 sampling contained a detectable concentration of any analyte. Diethylphthalate was detected in this equipment rinsate at a concentration of 2 µg/L. This analyte also was detected in the interbed sample at a concentration of 49 µg/kg.

For the WAG 5 groundwater monitoring sampling effort, a trip blank and a field blank were collected as required by the QAPjP. The trip blank contained no detectable concentrations of any of the analytes. The field blank contained calcium at levels several orders of magnitude lower than the sample concentrations.

3.2.1.3 Laboratory Precision and Accuracy. Laboratory precision and accuracy requirements are part of the validation criteria against which laboratory data are evaluated. More information on the validation of the OU 5-12 sampling and analysis results can be found in the limitations and validation reports previously submitted to DOE-ID, EPA, and IDHW. Laboratory precision is estimated through the use of duplicate and matrix spike duplicate samples. Laboratory accuracy is assessed through the use of matrix spikes and laboratory control samples. The number of laboratory QC samples is specified in the analytical methods employed and in the LMITCO Sample Management Office statements of work (or task order statements of work). Evaluation criteria for the QC samples are specified in data validation technical procedures for the LMITCO Sample Management Office. For samples analyzed in accordance with LMITCO Contract Laboratory Program (CLP) protocol, validation also is performed in accordance with CLP protocol.

3.2.2 Completeness

Completeness is a measure of the quantity of usable data collected during an investigation. The QAPjP requires that an overall completeness goal of 90% be achieved during an RI/FS. If critical parameters or samples are identified, a 100% completeness goal is specified in the QAPjP.

3.2.2.1 ARA-01. For ARA-01, all surface soil samples and boring samples are considered critical. The subsurface soil samples (i.e., 15 cm to 0.6 m [6 in. to 2 ft]) are considered critical only if they could be collected. The exception is those sampling locations for which the soil depth does not extend past 15 cm (6 in.) before basalt is encountered. All surface soil samples were collected and none was rejected during data method validation for a completeness of 100%. Five subsurface samples (15 cm to 0.6 m [6 in. to 2 ft]) could not be collected because basalt was encountered. Of the samples collected and analyzed from this depth range, none was rejected during method data validation for a completeness of 100%. Two boring samples were collected from the shallow depth for laboratory analysis and were not rejected for a completeness of 100%. Field analysis using a downhole gamma probe showed no gamma-emitting isotopes at the deeper depths; therefore, no other samples were collected at such depths for laboratory analysis.

3.2.2.2 ARA-02. For ARA-02, all samples are considered critical. The exception is those instances in which basalt was encountered before a given sampling depth could be reached. For the seepage pit, samples were collected from depths of 0.76 to 1.52 m (2.5 to 5 ft) and 2.29 to 3.05 m (7.5 to 10 ft) at which point basalt was encountered. For Septic Tank No. 1, samples were collected from depths of 0.76 to 1.52 m (2.5 to 5 ft) and 1.52 to 2.29 m (5 to 7.5 ft) at which point basalt was encountered. For Septic Tank No. 2, samples were collected from depths of 0.76 to 1.52 m (2.5 to 5 ft) and 2.29 to 3.05 m (7.5 to 10 ft) at which point basalt was encountered. For Septic Tank No. 3, samples were collected from

a depth of 0.76 to 1.52 m (2.5 to 5 ft) at which point basalt was encountered. It should be noted that when these tanks and the seepage pit were installed, they were originally placed at the basalt level.

The following analytical results for ARA-02 sampling were rejected during method data validation (only the field samples are summarized and not the field QC samples):

- Acrylamide results for all samples because the continuing calibration verification grossly exceeded quality control limits
- Cyclohexanone results for all samples because the initial calibration and continuing calibration relative response factor were less than the 0.05 quality control limit
- Isobutyl alcohol and n-butanol results for all samples because the initial calibration average relative response factors were less than the 0.05 quality control limit
- The 1,2-dibromo-3-chloropropane result for Sample 50200101VC (see the FSP [DOE-ID 1997] for sample locations) because the continuing calibration relative response factor was less than the 0.05 quality control limit
- The phthalic anhydride result for all samples because the initial calibration average relative response factor was less than the 0.05 quality control limit
- The hexachloropropene and 2-naphthylamine for all samples because the continuing calibration percent difference exceeded 75%
- The 4-aminobiphenyl and aramite results for Samples 50200201SV and 50200202SV (see the FSP [DOE-ID 1997] for sample locations) because the continuing calibration percent difference exceeded 75%
- The hexachloropropene, 2-naphthylamine, and phthalic anhydride results for Sample 50200401SV (see the FSP [DOE-ID 1997] for sample locations) because of calibration nonconformance.

While the results for the above analytes were rejected for various reasons, any concern should be tempered by the fact that the analyses performed during the 1996 septic system removal action at this site did not show the presence of any of the analytes found in the rejected results (Dietz 1998). Furthermore, the VOC and SVOC analytes are a small subset of a much larger population of analytes that was not rejected during the method data validation process. Therefore, the overall completeness for the ARA-02 sampling effort exceeds 99%. The impact of the rejected data is negligible because none of the rejected analytes is considered to be a COPC for ARA-02.

3.2.2.3 ARA-10. For ARA-10, all samples submitted for laboratory analysis are considered critical. As described in the sampling and analysis plan (DOE-ID 1997), one borehole was to be made at the ARA-10 site with a sample collected at a predetermined depth. If the field screening showed radioactivity above background levels for this sample, the borehole was to be extended with samples collected every 2 ft until field screening no longer showed radioactivity levels above background. Because field screening of the first sample showed no activity above background, no further sampling was required. The one sample was collected and was not rejected during method data validation for a completeness of 100%. The sample did not show the presence of any anthropogenic radionuclide at the detection limits employed.

3.2.2.4 ARA-16 Soils Sampling. For ARA-16 soils sampling, all samples are considered critical. The exception is those instances in which basalt was encountered before a given sampling depth was reached. Borehole samples from the exterior of the tank vault were collected, as described in Section 3.1.6.3. One sample was collected from the soils located centrally over the tank. Surface and subsurface sample collection inside the concrete vault is described in Section 3.1.6.2. Surface samples from the surrounding soils were collected as described in the FSP (DOE-ID 1997).

The following analytical results for ARA-16 soil sampling were rejected during method data validation (only the field samples are summarized and not the field QC samples):

- The nitrate, nitrite, and phosphate results for Sample 51600501AN (see the FSP [DOE-ID 1997] for sample locations) because the holding time was exceeded by a factor of two

- The bromide result for Sample 51600501AN (see the FSP [DOE-ID 1997] for sample locations) because of the poor performance in the low-level standard and the inconsistent information provided in preparation of the bromide intermediate standard

- The phthalic anhydride results for Samples 516015017P, 516016017P, 516017017P, and 516020017P (see the FSP [DOE-ID 1997] for sample locations) because the initial calibration average relative response factors were less than the 0.05 quality control limit

- The acid extractable compound result for Sample 516020017P (see the FSP [DOE-ID 1997] for sample locations) because the acid surrogate recovery was less than 10%

- The barium, calcium, and manganese results for Samples 51601001LA, 51601501L1, 51601601LA, 51601701LA, 51602001LA, and 51602401LA (see the FSP [DOE-ID 1997] for sample locations) because the laboratory duplicate RPDs exceeded 35%

- The isobutyl alcohol, n-butanol, and iodomethane nondetect results for Samples 51601501VG, 51601601VG, 51601701VG, and 51602001VG (see the FSP [DOE-ID 1997] for sample locations) because the continuing calibration relative response factors were less than the 0.05 quality control limit

- The iodomethane nondetect results for Samples 51601501VG, 51601601VG, 51601701VG, and 51602001VG (see the FSP [DOE-ID 1997] for sample locations) because the continuing calibration percent differences exceeded 75%

- The pentachloronitrobenzene and phthalic anhydride results for several samples because the initial calibration average relative response factors were less than the 0.05 quality control limit.

The rejection of nitrate, nitrite, and phosphate data for exceeding holding times is questionable because holding times are defined in terms of aqueous samples and are not necessarily applicable to soil samples. Though the bromide result was rejected, the analysis of the tank contents that showed bromide to be present only in the liquid phase at concentrations less than 0.4 mg/L and the lack of documented releases from the tank to the surrounding soils add credibility to the bromide nondetect result in the soil sample. The rejection of various VOC and SVOC analyte results is tempered by the analyses performed on the ARA-16 tank contents that did not show the presence of any of the rejected analytes. Furthermore, the VOC and SVOC analytes are a small subset of a much larger population of analytes that was not rejected during the method data validation process. As stated in the list above, the barium, calcium, and

manganese results were rejected for certain samples because the laboratory duplicate RPDs exceeded 35%. The RPDs for all other metals analyzed were acceptable, which indicated that the laboratory was in control and that exceeding the 35% level may be attributable to the natural heterogeneity of soils. Furthermore, none of these analytes is considered to be a COPC; therefore, the impact of the rejected data is negligible. Taking this into account, the overall completeness for the ARA-16 soil sampling effort exceeds 95%.

3.2.2.5 ARA-16 Tank Sampling. For the ARA-16 tank sampling, all samples are considered critical with the exception of those collected for analyses of physical (e.g., geotechnical) properties. Originally, Sample 51600201 and its duplicate (51600202) were to be analyzed for anions, cyanide, TCLP metals, and TCLP VOCs. Instead, Sample 51600401 was analyzed, which will have a negligible impact on the end use of the data.

The following analytical results for ARA-16 tank sampling were rejected during method data validation (only the field samples are summarized and not the field QC samples):

- The sulfur results for Samples 516002013A, 516002023A, 516002016A, and 516004019A because a pre-digestion matrix spike/matrix spike duplicate analysis was not performed, nor was a laboratory control sample analyzed
- The pH and total organic halide results for Samples 516037011G and 516037021G because the holding times were exceeded
- The nitrate and nitrite results for Samples 51600101AN and 51600102AN because of poor calibration standard recoveries
- The pH, flash point, and bulk density results for Samples 516038012G and 516038022G because the holding times were exceeded by more than a factor of two
- The nitrate, nitrite, and reactive sulfide results for Samples 516004019A, 516038012G, and 516038022G because the matrix spike recovery limits failed to meet the required recovery limits of 75 to 125%
- The fluoride and nitrate results for Sample 516004019A because the serial dilution sample exceeded the percent difference requirements
- The nondetect acetone results were rejected for Samples 516002013A, 516002016A, and 516002023A because the initial calibration average relative response factor was less than the 0.05 quality control limit.

The rejection of the data based on holding times is questionable because holding times are defined in terms of aqueous samples and are not necessarily applicable to sludge samples such as those obtained from the ARA-16 tank. The rejection of acetone results for the listed sludge samples has only negligible impact because acetone was not detected in liquid samples, which would be expected if it is indeed in the sludge. However, the rejection of sulfur, nitrate, nitrite, reactive sulfide, and fluoride results must be considered. The overall completion is greater than 95% for the ARA-16 tank sampling effort.

3.2.2.6 ARA-23. For ARA-23, sufficient data existed for risk assessment purposes; therefore, no samples were considered to be critical. A completeness goal of 90% is required by the QAPjP for noncritical samples. All samples specified in the sampling and analysis plan were collected. Two additional samples were collected in the field. All samples were analyzed, and no results were rejected

because of method data validation. Therefore, the overall completeness is 100% for the ARA-23 sampling effort.

3.2.2.7 PBF-31. For PBF-31, analytical samples for PAH, TPH, and SVOC analyses are considered critical. Opportunity samples for BTEX analysis and the gas samples collected for VOC analysis also are considered critical. All samples collected were analyzed, and no results were rejected because of method data validation. Therefore, the overall completeness is 100% for the PBF-31 sampling effort.

3.2.2.8 PBF-32. For PBF-32, analytical samples for PAH, TPH, and SVOC analyses are critical. Opportunity samples for BTEX analysis and the gas samples collected for VOC analysis also are considered critical. All samples collected were analyzed, and no results rejected because of method data validation. Therefore, the overall completeness is 100% for the PBF-32 sampling effort.

3.2.2.9 WAG 5 Groundwater Monitoring. For WAG 5 groundwater monitoring, no samples were defined to be critical; therefore, the overall completeness goal is 90%. All samples provided in the sampling and analysis plan table (DOE-ID 1997) were collected. Samples were analyzed as required for hydrazine, gross alpha and beta, anions, CLP metals, PCBs, gamma spectroscopy, tritium, I-129, and VOCs. If gross-alpha results exceeded 5 pCi/L, plutonium isotopic, uranium isotopic, and Am-241 analyses were to be performed. Likewise, if gross-beta results exceeded 5 pCi/L, Sr-90 and Tc-99 analyses were to be performed. Neither the gross-alpha nor the gross-beta results exceeded the 5 pCi/L threshold; therefore, no isotopic analyses were performed.

The following analytical results for WAG 5 groundwater monitoring were rejected during method data validation (only the field samples are summarized and not the field QC samples):

- Nondetect results for isobutyl alcohol and n-butanol for Samples 5GW10701VG and 5GW10702VG (see the FSP [DOE-ID 1997] for sample locations) because the initial calibration average relative response factors were less than the 0.05 quality control limit

- The isobutyl alcohol, 2-chloroethylvinylether, and n-butanol results for Samples 5GW10101VG, 5GW10201VG, 5GW10301VG, 5GW10401VG, 5GW10501VG, 5GW10601VG, 5GW10801VG, and 5GW10901VG (see the FSP [DOE-ID 1997] for sample locations) because the initial calibration relative response factors were less than the 0.05 quality control limit.

The rejected analytes have not been detected previously in the groundwater underlying WAG 5 and are not identified as contaminants of potential concern. Furthermore, these analytes are a small subset of a much larger population of analytes; therefore, the potential impact on the data is negligible. The overall completeness is greater than 95% for the WAG 5 groundwater monitoring effort.

3.2.3 Detection Limits

The analytical results obtained in this investigation were used to complete the BRA for the WAG 5 comprehensive RI/FS and to characterize the nature and extent of contamination at the subject sites. For the risk assessment, acceptable detection limits are either regulatory (e.g., based on maximum contaminant levels [MCLs]) or risk based.

The analytical laboratories provide all positive results for analytes even if results are less than the contract-required quantitation limit (CRQL) for organics or contract-required detection limit (CRDL) for organics. Radiochemistry results are always reported with an associated uncertainty regardless of the CRDL. Unless the results are rejected as unusable during the process of data validation, all results are

used to characterize the associated risk and the nature and extent of contamination at a site. However, the organic compounds that are detected at levels below the CRQL and CRDLs are generally flagged with a "J" to indicate estimated values. The CRQLs are chemical and sample matrix-specific concentrations that a laboratory must be able to routinely and reliably detect and quantify when using the analytical method specified in the laboratory and CLP statements of work (or task order statements of work). The limitations and validation reports previously submitted to DOE-ID, the EPA, and IDHW, as well as the data presented in Appendix E, summarize the "J" flags assigned to data obtained from a laboratory.

3.2.4 Comparability and Representativeness

Comparability is a qualitative characteristic that refers to the confidence with which one data set can be compared to another. At a minimum, comparable data must be obtained using unbiased sample designs. If sampling designs are not unbiased, the reasons for selecting another design should be well documented. Representativeness is a qualitative parameter that expresses the degree to which the sampling and analysis data reflect the characteristics being measured. The representativeness criterion is best satisfied by confirming that sampling locations are selected properly and a sufficient number of samples are collected to meet the confidence level required by the intended use of the data.

Though several of the sampling designs for individual sites were biased, as noted in the following sections, data comparability was ensured through the use of standard sample collection techniques with adherence to QA/QC in accordance with the QAPjP (Baumer, Flynn, and Watkins 1995), the use of field QC samples, and the use of standard analytical methods by the laboratories. The data collected for each of the sites are intended to supplement historical analytical data, field screening information, and process knowledge. Therefore, the combined knowledge obtained from all of those sources ensures that the data collected are representative of each site.

3.2.4.1 ARA-01. The objective of the ARA-01 sampling was to supplement the existing sampling and analysis data. First, it was concluded that the risk from Cs-137 was acceptable based on surface and subsurface sampling (Stanisich et al. 1992). Because the samples were collected from a shallow depth, a data need was identified to determine the vertical extent of the contamination. To meet the data need, two boreholes were drilled at biased locations and samples were collected from the first depth interval because downhole gamma logging did not show the presence of Cs-137 at any greater depths. The biased samples were collected at the location of the highest Cs-137 concentration listed in the remedial investigation report (Stanisich et al. 1992) and in the area of the ARA-01 Chemical Evaporation Pond with the lowest elevation above sea level.

The second data need was to determine the presence and average concentrations of alpha-emitting isotopes and Sr-90. During the remedial investigation (Stanisich et al. 1992), one sample was analyzed for alpha isotopes. The sample was biased toward the area with higher activity and showed concentrations of Pu-239 and U-234 at levels of 2.6 and 1.6 pCi/g, respectively. A sample was not collected for Sr-90 analysis. To adequately meet the data need, additional samples were required for alpha-isotopic and Sr-90 analyses. The sampling locations were selected randomly leading to an unbiased sampling design.

3.2.4.2 ARA-02. The primary data need at ARA-02 is to ensure that contamination located within the septic system located at ARA-02 has not affected the surrounding soils. The area of greatest concern for soil contamination is the ARA-02 seepage pit because the seepage pit has no bottom and is open to the basalt beneath it. Secondary to the pit, the soils surrounding the three tanks that make up the remainder of the septic system have a potential for contamination, especially if any of the tanks breached before the 1996 removal of their contents. Samples were collected from boreholes drilled adjacent to each tank and

the seepage pit. The boreholes were drilled to basalt, and the samples were collected at various depths down to the basalt layer.

3.2.4.3 ARA-10. The primary data need at ARA-10 was to collect a sample from soils underlying the former location of the ARA-10 septic tank to demonstrate that no contamination exists at this site. A single sample was collected at a predetermined depth biased toward the estimated bottom depth of the tank.

3.2.4.4 ARA-16. Five separate potential contamination areas or sources are associated with the ARA-16 radionuclide tank: the tank contents, the surface and subsurface soil and gravel within the concrete vault surrounding the tank, the surface and subsurface soil outside but immediately adjacent to the concrete vault, the soils in the surrounding ARA-16 site, and the concrete vault itself.

For the ARA-16 tank contents, the primary data need was to sufficiently characterize the tank contents so that an appropriate disposal method could be identified. The objective was to supplement previous sampling conducted in 1988. Samples were collected from each of the two phases in the tank, sludge and liquid.

The surface and subsurface soil and gravel within the concrete vault were suspected to have been contaminated because of leaks and spills during pumping or filling operations associated with the tank. It is not known whether the tank itself has leaked in the past. Boreholes were drilled in each of the four corners of the concrete vault with samples collected from both the top and bottom of each borehole. Furthermore, a sample was collected from the soils immediately over the tank. These data were required to estimate the nature and extent of the contamination and to provide supplemental data to evaluate possible remedial actions.

Likewise, the surface and subsurface soils immediately adjacent to the concrete vault may have been contaminated during operations conducted at the tank or because of migration of contamination through the concrete vault walls. Two boreholes were drilled next to the vault, and samples were collected from the top and bottom of each borehole.

In addition, surface soils in the remainder of the ARA-16 site were sampled to determine the nature and extent of contamination in the area. A sample grid was defined, and samples were systematically collected at predetermined locations surrounding the vault. These samples will be used to estimate the extent of contamination.

3.2.4.5 ARA-23. The purpose for sampling at ARA-23 was two-fold. First, supplemental data were needed to define the extent of the radionuclide contamination at the site. Vehicle-mounted and hand-held gamma-detecting instruments were used to map the surface contamination at ARA-23. A map was created that showed isopleths based on Cs-137 concentrations. Soil samples were collected to validate the survey results.

The second purpose for sampling at ARA-23 was to provide data to determine the presence of other radionuclides. The Cs-137 concentrations found during previous investigations were used to identify the probable locations of other radionuclides. Three biased samples were collected at locations determined to be high in Cs-137. Samples were collected at depths of 0 to 15 cm (0 to 6 in.) and 15 cm to 0.6 m (6 in. to 2 ft) and were analyzed for alpha-emitting isotopes and Sr-90. Alpha-emitting isotopes (i.e., uranium and thorium) were at background concentrations. Anthropogenic alpha-emitting isotopes (i.e., plutonium and Am-241) were at or below the method detection limit, and Sr-90 was detected.

3.2.4.6 PBF-31 and PBF-32. The objective of the sampling efforts at the PBF-31 and PBF-32 sites was to determine whether any contamination exists that could be attributed to the presence of either the SPERT-II fuel oil tank or the PBF Control Area fuel oil tank at PBF-31 and PBF-32, respectively. A borehole was drilled to the 110-ft interbed at each site. Opportunity samples for BTEX analysis were collected during the drilling operations, and samples were collected from the interbed after completion of the borehole. Three vapor ports were installed at different depths to allow the collection of VOC gas samples after the areas surrounding the boreholes equilibrated.

3.2.4.7 WAG 5 Groundwater. The objective of the WAG 5 groundwater sampling effort was to collect monitoring data to determine whether contemporary or historical WAG 5 operations may have contaminated the groundwater underlying the area. Samples were collected from the following wells: ARA-MON-A-001, ARA-MON-A-002, ARA-MON-A-003A, ARA-MON-A-004, PBF-MON-A-001, PBF-MON-A-003, PBF-MON-A-004, PBF-MON-A-005, and SPERT-I. The analytical data are interpreted in conjunction with historical data in Section 4.

3.2.5 Quality Assurance/Quality Control Summary

3.2.5.1 Precision. For sites ARA-01, ARA-02, ARA-16 (soils), ARA-23 and for WAG-5 groundwater monitoring, the precision is fairly good for the majority of analytes. However, there are certain exceptions, and these must be taken into account when performing the risk assessment calculations. High imprecision is noted in those cases for which one result is a detected concentration and the other is a reported detection limit. The imprecision is primarily attributed to laboratory dilution factors resulting in the detection limit for a duplicate being much higher than the quantitation limit for the corresponding sample. For the ARA-16 tank samples, high imprecision was encountered, which is directly attributed to the heterogeneity of the tank contents. The imprecision was to be expected and does not invalidate the data for its intended use.

3.2.5.2 Accuracy. For the ARA-02, ARA-16 (soils and tank), ARA-23, and PBF-31 sites, certain contaminants were detected in the blanks, which may have contributed to the detection of the contaminants in the samples. It is difficult to directly compare analyte concentrations in the blanks, which are aqueous, to those in samples, which are of a different matrix. However, the detection of the contaminants in the blanks is limited to a few analytes. Overall, few contaminants were detected in the blanks compared to the number analyzed and detected in the samples. Analytes for which contaminated blanks were found were not eliminated because including the biased data is conservative.

3.2.5.3 Completeness. As summarized in Section 3.2.2, completeness for each sample site exceeds 90%. Analytical results for a limited number of analytes were rejected because of holding times being exceeded or out-of-control analytical laboratory conditions. Defined based on drinking water regulations, holding times should be viewed with some skepticism when applied to soil samples or waste samples that have been exposed to wide temperature variations as a natural state of conditions. Frequently, a contaminant result that was rejected because of analytical controls was not actually detected in the sample nor was it present in the source of the contamination; therefore, rejection of the analytical result does not adversely affect the overall sampling objective. Overall completeness of the WAG 5 sampling project exceeds 95%.

3.2.5.4 Comparability. Comparability was ensured through the use of standard sample collection techniques, with adherence to QA/QC in accordance with the QAPjP; the use of field QC samples; and the use of standard analytical methods by the laboratories. This requirement was met for all sites as described in Section 3.2.4.

3.2.5.5 Representativeness. Representativeness was satisfied by confirmation that the sampling locations were properly selected. A sufficient number of samples were collected to provide for the confidence level required for the risk assessment.

3.3 Facilities Assessment Analysis

Because past and present activities associated with ARA and PBF facilities and structures are proximal or "co-located" to WAG 5 CERCLA sites, an analysis was performed to assess their potential impacts to cumulative risk estimates and to ensure that all historical releases were identified and assessed. The analysis included a review of past and present operational activities at ARA and PBF, existing facilities and structures, and LMITCO management control procedures (MCPs) for mitigating the effects of future environmental releases of contaminants. Screening criteria for eliminating or retaining buildings and structures in the facilities assessment analysis were developed and applied to each of the WAG 5 facilities and structures. All current operations, facilities and structures no longer being used for their original missions, and facilities in standby or abandoned mode were addressed. Appendix C contains a complete description of the analysis. The results are summarized below.

3.3.1 Auxiliary Reactor Area

The majority of the ARA facilities are in the final stages of D&D. Because no contemporary programs other than D&D are being implemented at ARA-I, II, and III, MCPs to mitigate potential environmental releases from operations are not applicable. Therefore, the facilities assessment analysis for ARA was based primarily on interviews, an exhaustive review of engineering drawings, and INEEL technical site information drawings for ARA I, II, III, and IV (which were last updated in December 1996), and onsite inspections of the areas. The D&D process at ARA is implemented in compliance with RCRA (42 USC § 6901 et seq.), the Toxic Substance Control Act (TSCA) (15 USC § 53; 40 CFR 700–799), and DOE Order 5820.2A. In addition to limiting residual radioactive potential uptake to 100 mrem/year, DOE Order 5820.2A provides a description of the coordination of D&D activities relative to any nearby CERCLA sites. The D&D program personnel are familiar with the known CERCLA sites and inform the WAG 5 manager if previously unidentified contamination is found. The new site identification process is initiated to determine whether the contamination is a past release subject to CERCLA. The parties to the FFA/CO, DOE-ID, EPA, and IDHW, then determine whether to add the site. A memorandum of understanding between WAG 5 and the D&D program (Kenoyer 1994) also outlines the relationships involving common sites. The facilities assessment revealed that appropriate controls are in place to address the potential release of contaminants at ARA. No other operations are currently planned after D&D is completed at ARA-I, -II, and -III. The ARA-IV area is currently used for explosive testing, and controls are in place to minimize potential releases to the environment. All other facilities that have the potential to impact comprehensive risk at ARA are CERCLA sites that are addressed in the BRA.

3.3.2 Power Burst Facility

Unlike ARA, PBF is an active operational area. Therefore, for PBF, the facilities assessment (Appendix C) relied more heavily on MCPs. The documents and procedures used to mitigate potential releases to the environment include safety analysis reports for nuclear facilities, RCRA contingency plans, closure and post-closure plans, and applicable permits. The facilities assessment evaluation considered all PBF operational facilities and structures, facilities and structures no longer being used for their original missions, and facilities in standby or abandoned mode. Past and current uses of structures and buildings were investigated. Proximal facilities and structures at PBF were evaluated based on the following criteria:

- The facility has not processed, stored, or used hazardous materials or waste. Facilities eliminated on the basis of this criterion include personnel offices, nonhazardous material storage areas, training and security buildings, personnel support buildings, nonhazardous liquid storage structures (i.e., raw water storage tanks and towers), electrically driven raw pumping facilities, and facility maintenance shops.

- The facility is scheduled for D&D.

- Facility operations are permitted through other programs.

- The facility or structure has no history of past releases that would impact the cumulative risk at WAG 5 and is currently operated with appropriate management controls.

- The facility or structure is currently operated under appropriate management control programs to prevent and respond to potential releases, and historical releases have been evaluated.

Buildings and structures with a history of releases not under current, appropriate management controls and those that possess the potential to impact cumulative risk at WAG5 sites normally would be retained for consideration in the BRA. However, no such facilities or structures were identified in the facilities assessment analysis for PBF. The proximal facilities at PBF and the associated documents and management procedures are given in Appendix C.

3.4 Site and Contaminant Screening

The WAG 5 Work Plan (DOE-ID 1997) included a preliminary screening of the 54 sites identified within the ARA and PBF. The screening was reviewed for the comprehensive RI/FS to ensure that no sites were eliminated inappropriately from evaluation in the cumulative risk assessment and to focus resources on those sites that could contribute to cumulative risk. The final site screening for the BRA is presented below to reduce the number of sites that must be addressed in the nature and extent of contamination, fate and transport, and human health baseline risk assessment discussions that follow in Sections 4, 5, and 6, respectively. Section 7 addresses site screening specific to the ecological risk assessment. A summary of the status of each site in WAG 5 before screening for the BRA was applied is provided, as presented in the Work Plan (DOE-ID 1997), in Table 3-1.

The site screening for the BRA consisted of reviewing the previous evaluations and newly acquired information associated with each site to assess the potential contributions to cumulative risk. The screening consisted of four steps: (1) source identification, (2) review of previous risk evaluations, (3) contaminant screening, and (4) review of site-specific factors. The first three steps, performed in accordance with the INEEL guidance for cumulative risk assessment (LMITCO May 1995), are illustrated in Figure 3-1. The fourth step is an evaluation of site-specific factors that could justify screening the site from quantitative evaluation in the BRA. Therefore, sites were eliminated on the basis of one of the four following site-screening criteria:

1. No contaminant source is present at the site.

2. The total risk is less than or equal to 1E-07, and the hazard index is less than or equal to 0.1. Results from qualitative evaluations (e.g., Track 1 risk assessments) are considered below those levels if qualitative risk and uncertainty are both low.